PREFACE

F. L. Timmons

The following assembled report of the Research Committee of the North Central Weed Control Conference comprises approximately two hundred pages and is a combination of the separate reports of thirteen subcommittees assigned different phases of weed control research on 2,4-D and other selective herbicides. Each of the subcommittee reports consists of abstracts and condensed tables submitted by individual investigators reporting results in experiments on the control of a specific weed or on a designated phase of the use of herbicides and their effects on weeds or crops. The assembled abstracts and tables are preceded in each case by a regional summary of trends and points of special interest in the individual reports.

The pages of each of the subcommittee reports are numbered consecutively beginning with page 1. This will make possible citations of and references to any specific abstract by page in the topical section in which it appears. The subcommittee reports of results on the various topics are arranged in this combined report in the same order that the subcommittees are listed under "Research Committee Membership and Organization" on the back of this page. The list of subcommittees can therefore be used as a table of contents of this combined report. The subcommittee reports vary in length from 4 to 48 pages.

The combined report includes abstracts from eighty investigators, located in twenty-four states of the United States and six provinces of Canada, reporting results of 225 experiments on the various phases of research with 2,4-D and other herbicides. Most of the reports from outside of the North Central Conference are on the control of woody plants. Nearly all of the reports are on results of research conducted in 1946 and 1947. In some cases the abstracts report progress of incomplete experiments on the control of perennial herbaceous or woody species of weeds. Abstracts from nearly all weed research workers in the Conference are included. Thus, this report probably assembles references to and brief reports on most of the weed control research that has been completed during 1946 and 1947 or is underway in the North Central States and Canada. The report on control of woody plants is much wider in scope.

Most of the research reported upon, except that on control of woody plants, followed more or less closely a uniform plan of experiments which has been sponsored by the Research Committee in 1945, 1946, and 1947. The uniform plan, revised each year to provide for new developments, has aided greatly in encouraging new research, in making available to all investigators the pooled judgment and planning of their co-workers, and in coordinating research efforts along definite and productive lines of approach. As a follow-up of this uniform program, a regional plan of interstate cooperative weed research, to be activated under United States Public Law 733, has been prepared by a committee under the leadership of Dr. C. J. Willard, Ohio State University. This plan, if approved and activated, should greatly increase the amount and effectiveness of basic weed research in the North Central States region.

RESEARCH COMMITTEE MEMBERSHIP AND ORGANIZATION

CHAIRMAN - Mr. F. L. Timmons, USDA, Bureau of Plant Industry, Soils and Agricultural Engineering, Hays Experiment Station, Hays, Kans.

VICE-CHAIRMAN - Dr. C. J. Willard, Dept. of Agronomy, Ohio State University, Columbus 10, Ohio

SUBCOMMITTEES:

Uniform Experiments:

Bindweed (west half of conference) - Mr. Lyle A. Derscheid, Dept. of Agronomy, South Dakota State College, Brookings, S.D.

Bindweed (east half of conference) - Dr. R. F. Fuelleman, Dept. of Agronomy, University of Illinois, Urbana, Ill.

Canada thistle - Dr. A. L. Bakke - Dept. of Botany, Iowa State College, Ames, Iowa

Hoary cress - Mr. J. W. Zahnley, Dept. of Agronomy, Kansas State College, Manhattan, Kans.

Leafy spurge - Mr. H. E. Wood, Weeds Commission, Department of Agriculture and Immigration, Winnepeg, Manitoba

Perennial sow thistle - Mr. George Knowles, Department of Agriculture, Central Experimental Farm, Ottawa, Canada

Texas blueweed - Mr. W. C. Elder, Dept. of Agronomy, Oklahoma A. & M. College, Stillwater, Okla.

All other herbaceous perennial weeds - Dr. K. P. Buchholtz, Dept. of Agronomy, University of Wisconsin, Madison, Wis.

Annual and winter annual weeds in small grains, grasses and flax - Dr. L. M. Stahler, USDA, Bureau of Plant Industry, Soils and Agricultural Engineering, Lamberton, Minnesota

Relation of stage of growth in annual weeds to effectiveness of 2,4-D treatment- Mr. O. C. Lee, Dept. of Botany, Purdue University, Lafayette, Indiana

Effects of 2,4-D post-emergence treatments on crops - Mr. Glenn Viehmeyer, University of Nebraska Substation, North Platte, Nebraska

Effects of 2,4-D pre-emergence treatments on crops and weeds - Mr. R. S. Dunham, Div. of Agronomy and Plant Genetics, University Farm, St. Paul, Minnesota

Non-uniform Experiments:

Control of woody plants - Dr. L. W. Mclander, USDA, Bureau of Entomology & Plant Quarantine, 111 Federal Office Bldg., Minneapolis 1, Minn.

2,4-D and combinations with other methods on annual and herbaceous perennial weeds - Dr. W. C. Dutton, Agricultural Chemicals Section, Dow Chemical Company, Midland, Michigan

Other herbicides - Dr. E. D. Witman, Sherwin-Williams Company, Dept. of Agricultural Chemistry, Ohio State University, Columbus 10, Ohio

Other Committee Members:

Dr. B. H. Grigsby, Dept. of Botany, Michigan State College, East Lansing

Mr. Noel S. Hanson, Dept. of Agronomy, University of Nebraska, Lincoln

Dr. E. A. Helgeson, Dept. of Botany, North Dakota State College, Fargo

Mr. C. A. Helm, Dept. of Agronomy, University of Missouri, Columbia

Mr. A. H. Larson, Div. of Agric. Botany, University Farm, St. Paul, Minn.

Mr. G. L. McCall, E. I. DuPont de Nemours Co., Dept. of Entomology, Ohio State University. Columbus 10, Ohio

Dr. T. K. Pavlychenko, Plant Ecology Laboratory, University of Saskatchewan, Saskatoon, Saskatchewan

Mr. Vernon Woestemeyer, Bindweed Experimental Farm, Canton, Kansas

Dr. M. W. Worzella, Dept. of Agronomy, South Dakota State College, Brookings, S.D.

RESULTS OF UNIFORM EXPERIMENTS WITH 2,4-D ON BINDWEED

Uniform Experiment No. I.

REGIONAL SUMMARY

by

Lyle A. Derscheid

There are several striking observations that can be made from a review of the abstracts submitted.

The first and perhaps the most important observation that can be made is the close correlation between good bindweed kills and the good growing conditions. This observation was not reported by all investigators, but it is reported by three men, who seem to be in complete agreement. Timmons, Elder and Derscheid point out that good kills were obtained the fall of 1946 when there was an abundance of soil moisture. Timmons and Derscheid also mention the dry spring of 1946 and Timmons mentions the dry summer of 1946. Treatments made during these dry periods were rather ineffective. Timmons also mentioned the abundance of soil moisture during the summer of 1947 accompanied by what appears to be effective applications of 2,4-D. Helgeson reports more effective control with 2,4-D on fallow land than on grass land and more satisfactory results in eastern North Dakota than in the western areas; there is generally more soil moisture on fallow land than on grass land, and eastern North Dakota usually has more precipitation than the western portion of the state. Elder states that treatments made just before frost resulted in less than a 60 percent kill; whereas Derscheid found that treatments, made two weeks after a late spring frost, resulted in less than a 50 percent kill. Good kills were obtained in the full emergence, bud, full bloom, and fall stages of growth, whenever there was an abundance of soil moisture and provided that treatments were not made shortly before or after a frost.

A review of the various abstracts makes it difficult to determine if one formulation is more effective on field bindweed than another. It appears, however, that when good growing conditions prevail, there is little difference in formulations, but that the ester is slightly more effective in slightly adverse conditions. Timmons' 1946 applications show little difference between formulations in the fall treatments when there was an abundance of moisture, but the ester was more effective for the bud stage when the growing conditions were not as desirable. Woestemeyer reports little difference between formulations for the full emergence and first bud treatments, but his data show the sodium salts to be slightly more effective in the late fall treatment when growing conditions were probably good; the average of the two amines, however, is better than the averages of two sodium salts or three esters for the full bloom applications. The 1947 applications made by Timmons and by Derscheid show little difference between spray formulations, with the exception of the first bud treatment made by Timmons where the ester appears to be more effective. Helgeson reports that differences between formulations could not be detected in a series of several experiments, Elder and Timmons both report no difference in formulations if two pounds or more are used, whereas Derscheid reports no difference if 1 1/3 pounds are used. Derscheid reports the esters and amines are slightly more effective than the sodium salt when only 2/3 pound was used. It will be noticed, however, that poor results from the sodium salts, in most cases, may be attributed to the fact that monohydrate sodium salts were not used. The writer has found that most monohydrate sodium salts are more soluble in water, and believes that is an important factor. Monohydrate sodium salts were used throughout the year of 1947 and results appear to be better than those obtained in previous years.

Bisal and Ficht agree that there is no difference in effectiveness of formulations when one pound of acid is used on an acre of hedge bindweed (wild morning glory). Ficht, however, indicates that ½ pound of ester or amine is more effective than ½ pound of sodium salt. This may also be due to the fact that a monohydrate sodium salt was not used.

The minimum amount of 2,4-D needed for consistent and effective control of bindweed will depend largely upon growing conditions. One pound of 2,4-D acid appears to be sufficient when growing conditions are favorable. This is borne out primarily by the effective applications made by Timmons and Derscheid in the fall of 1946 and the spring of 1947. Derscheid was able to get effective control with as little as two-thirds of a pound of 2,4-D. The data presented by Paveychenko indicates that at least one and one-half pounds are necessary for effective control, but the growing conditions present at the time of application are not known to the writer. Bisal, however, obtained a 100 percent kill with one pound of an ester. Timmons, Elder, and Woestemeyer indicate that there is little advantage in using over two pounds of 2,4-D acid to the acre. When soil moisture was not abundant, however, Timmons did gain more effective elimination by increasing the concentration of all chemicals but the ester. The increase in effect is not great enough to make the kill very satisfactory except where four pounds of amine were used on the bud stage of growth. Helgeson indicates that there is a difference obtained by the use of different rates of application, but does not indicate which rate is the most effective.

Bisal and Ficht agree that one pound of 2,4-D acid is sufficient for satisfactory elimination of hedge bindweed, but Ficht was able to get effective control by the use of one-half pound of an ester or amine.

It would seem, therefore, that favorable growing conditions are of utmost importance. It is also apparent that rate of growth is more important than the stage of growth. If the rate of growth is rapid, one pound of any formulation appears to be effective on field bindweed; in some cases, less than one pound is sufficient. One-half pound of an ester or an amine is sufficient 2,4-D for effective control of hedge bindweed. If the rate of growth is slow, an ester should be used or increase the concentration of other formulations up to somewhere between one and two pounds.

ABSTRACTS

FACTORS INFLUENCING THE EFFECTIVENESS OF 2,4-D ON BINDWEEDS IN 1946

by

W. C. Elder

Three types of 2,4-D were used on bindweeds at the rate of 2, 3, and 4 lbs. per acre using 1½ gal. of water per sq. rod. Applications were made in spring full emergence, bud stage, in fall after regrowth from summer dormancy and just before killing frosts.

Counts made one year after treatment show that there was little difference in results from using amine, salt, and ester types of 2,4-D where 2 lbs. per acre or more was used.

Ninety percent of the bindweeds were killed by the first fall application. Eighty to ninety percent was eradicated by spring bud stage applications. Applications made just before frost time and at emergence killed less than 60 percent.

The first fall stage application was made in 1946 under very favorable conditions. There was plenty of moisture and the bindweeds had made rapid growth since summer dormancy. Conditions were not favorable for fall treatments in 1947, and most years are not favorable for fall treatments.

THE RELATION OF GROWTH AND RATE OF APPLICATION TO THE EFFECTIVENESS OF DIFFERENT TYPES OF 2,4-D FORMULATIONS FOR THE CONTROL OF FIELD BINDWEED

by

Lyle A. Derscheid*

A monohydrate sodium salt, a triethanolamine, a butyl ester, an isopropyl ester dust, and a sodium salt dust of 2,4-D were compared in duplicate on bindweed at the rates of 5/8, 1¼, 1 7/8, and 2½ pounds of 2,4-D acid equivalent per acre. Field bindweed was treated at full emergence, full bloom and fall stages of growth in 1947. Plant stand estimates were made in October of the same year.

The "full emergence" treatment was made June 5th when temperatures were around 70° F. and after an unusually wet spring. All treatments except the sodium salt dust appeared to have killed over 90 percent of the original stand. All concentrations of the sodium salt dust produced less than a 50 percent kill.

The "full bloom" treatments were made July 22nd after a rainless period of 30 days. The sodium salt dust appeared to be least effective, but otherwise, no difference in chemicals could be noted. The three heavier concentrations of the other chemicals appear to have killed 70-75 percent of the bindweed plants, whereas the lightest concentration eliminated about 60 percent.

The "fall treatment" was made September 18th after a long dry spell. Observations in October did not promise a satisfactory kill.

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* Experiment conducted in cooperation with L. M. Stahler

THE RELATION OF GROWTH AND RATE OF APPLICATION TO THE EFFECTIVENESS OF DIFFERENT TYPES OF 2,4-D FORMULATIONS FOR THE CONTROL OF FIELD BINDWEED

by

Lyle A. Derscheid*

Anhydrous sodium, ammonium, and triethanolamine salts and the ethyl and butyl esters of 2,4-D were compared in duplicated spray applications of 2/3, 1 1/3, 2, and 2 2/3 pounds of 2,4-D acid equivalent per acre. Field bindweed was treated at full emergence, full bloom and fall stages of growth in 1946. No retreatments were made, but plant counts were made in 1947.

The "full emergence" treatment was made May 28th, two weeks after a killing frost, when there was a below average amount of soil moisture. The esters ranked first, followed by the amine with the ammonium and sodium salts the poorest, but no treatments gave better than a 50 percent kill.

The "full bloom" treatments were made July 9th when there was an abundance of soil moisture and warm temperatures. The 2/3 pound of ammonium and sodium salts produced an 80-85 percent kill, but all other treatments produced a 90-95 percent kill of bindweed.

The fall treatments were made September 11th after having had 7.5 inches of rain the preceding month. An 85-90 percent kill was obtained by all treatments.

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* Experiment conducted in cooperation with L. M. Stahler

THE INFLUENCE OF STAGE OF GROWTH, 2,4-D FORMULATION, AND CONCENTRATION OF APPLICATION ON FIELD BINDWEED

by

V. W. Woestemeyer

Preparations of 2,4-D were used at concentrations of 1000, 1500, and 2000 ppm and applied at the rate of 1½ gal. per sq. rod at the following stages: full emergence (May 18), appearance of first bud (May 24), full bloom (June 8), summer dormancy (Aug. 9) and late fall (Oct. 15). Results are averages of duplicate plots observed 90 days after treatment, except for summer dormancy, observed 60 days after, and late fall observed May 5, 1947.

Due to erratic appearance of bindweed plants, the first two applications are close together, but differences were observed. Applications made at appearance of first bud gave greatest percent reduction (94), followed by full emergence (91.6), late fall (85.3), full bloom (79.6) with summer dormancy being least effective (19.5). Esters were slightly more effective at full emergence, full bloom, and late fall; salts at appearance of first bud; and acids at summer dormancy. Only minor variations resulted from different concentrations.

In most cases, top growth was not completely killed and new shoots emerged within 60 days. Top growth reacted most rapidly to ester types with the acid being only slightly slower. The salts and amines were about equal in giving relatively slow kills.

The Influence of Stage of Growth, 2,4-D Formulation, and Concentration of Application on Field Bindweed

Product	% 2,4-D Acid	Type	Per Cent Reduction of Bindweed Stand[1]				
			Full Emergence	Appearance of First Bud	Full Bloom	Summer Dormancy	Late Fall
Chipman	60	Sodium Salt	90.77	95.64	74.57	19.24	94.23
2,4-Dow Weed Killer Powder	70	" "	92.20	95.20	68.57	32.17	91.33
2,4-Dow Weed Killer Liquid	20	Triethanol-amine salt	91.67	91.63	82.37	4.66	81.74
Tufor 40	40	" "	92.74	94.77	90.10	5.84	70.94
Weedanol M1	16.6	2,4-D acid in cosolvent	92.23	92.67	75.24	55.77	84.95
Weedone	9.6	Ethyl Ester	94.00	94.37	71.20	59.10	62.80
Dow G-654	12	Methyl Ester	92.60	93.00	75.94	4.64	96.60
Weed-No-More 40	32	Butyl Ester	92.10	94.57	89.04	-46.66	95.24
AVERAGE			92.29	93.98	78.38	16.85	84.73

1. Average of concentrations of 1000, 1500, and 2000 ppm, $1\frac{1}{2}$ gal. per sq. rod

ERADICATION OF FIELD BINDWEED BY 2,4-D

by

T. K. Pavlychenko

On July 5, 1945, four isolated patches of field bindweed on a heavy clay loam soil were treated at the blooming stage with ethyl ester (Weedone) at three rates: 1000, 1500, and 2000 ppm or 1, 1½, and 2 pounds of acid equivalent/acre.

Results: The records taken one month after the treatment showed 100 percent kill of the top growth in all plots. The counts taken later in the fall of 1945, 1946, and 1947 revealed some regrowth which was expressed in percentages of the original stand of the respective plots.

Rate of application pounds/acre acid equivalent	PERCENT REGROWTH			
	One month after treatment	Fall of: 1945	1946	1947
1	0	42	61	72
1½	0	6	2	14
2	0	0	0	0

THE RELATION OF STAGE OF GROWTH AND RATE OF APPLICATION TO THE EFFECTIVENESS OF DIFFERENT TYPES OF 2,4-D FORMULATIONS IN ERADICATING FIELD BINDWEED

by

F. L. Timmons

The sodium and triethanolamine salts of 2,4-D were compared in triplicated spray applications at rates of 1, 2, 3, and 4 pounds of 2,4-D per acre, on bindweed at full emergence, bud, full bloom, and fall stages of growth in 1946. The butyl ester of 2,4-D and 2,4-D acid in carbowax at equivalent rates were included in the comparisons at the bud and fall growth stages. All treatments were repeated on bindweed regrowth in 1947 at the corresponding stages of growth.

Spray applications made April 20, May 4, and May 18 at the three earlier stages of growth in 1946 gave about the same results and all were considerably less effective than treatments made October 15. Results from retreatments made at full bloom and bud stages in 1947 were much better than those made at full emergence of bindweed regrowth. Abnormally dry soil early in 1946 and unusually wet soil in the fall of 1946 and spring of 1947 may account for these differences.

Heavier rates of application tended to cause greater reductions in bindweed for all formulations except the butyl ester. One pound of butyl ester per acre was about as effective as any heavier rate, was much more effective than equivalent amounts of the other formulations, and in most cases was somewhat more effective than the heavier rates of the other products. None of the treatments gave complete eradication of bindweed.

The relation of stage of growth and rate of application to the effectiveness of different types of 2,4-D formulations in eradicating field bindweed at the Fort Hays Experiment Station, Hays, Kansas. NCWCC Uniform Exp. No. I-2, 1946. Summary of data for 1946 and 1947.

Type of 2,4-D product used. Trade name given in ()	Rate, lbs. of 2,4-D per acre (1)	Percent of bindweed regrowth after original treatments in 1946 and retreatments in 1947 at different stages of growth (2)							
		Full emergence		Bud to early bloom		Full bloom		Fall growth, no bloom	
		Original (1 yr.)	Retreatment (4 mo.)	Original (1 yr.)	Retreatment (4 mo.)	Original (1 yr.)	Retreatment (4 mo.)	Original (8 mo.)	Treatment
Sodium salt (2,4-Dow Weed Killer, Powdered)	1	28	17	33	5.0	24	1.4	11	9
	2	15	13	30	7.7	22	1.3	8	3
	3	23	13	17	3.8	8	.2	3	3
	4	19	17	17	2.2	11	.1	8	4
	Average	21	15	24	4.7	16	.8	8	5
Triethanolamine salt (Tufor 40)	1	20	13	43	3.1	28	.9	16	9
	2	21	9	36	3.6	30	1.6	14	10
	3	11	18	25	3.9	24	1.6	21	18
	4	19	26	7	2.4	19	2.9	7	13
	Average	18	17	28	3.3	25	1.8	15	13
Free acid in a carrier (Weedanol M1)	1			40	8.9			10	10
	2			22	7.8			7	10
	3			16	3.0			4	5
	4			16	3.4			6	3
	Average			24	5.8			7	7
Butyl ester (Weed-no-more)	1*			12	1.6			6	6
	2*			11	1.8			2	5
	3*			13	1.5			4	6
	4*			12	3.6			4	8
	Average			12	2.1			4	6

(1) Retreatments in 1947 were made approximately a year later than the original treatments in 1946 at the same stages of growth and rates of application.

(2) All data are averages of three replications. Time elapsed between treatments and recording of results is shown in parenthesis.

* Given as weight of butyl ester which actually contains only 80 percent 2,4-D acid equivalent.

TOLERANCE OF FIELD BINDWEED IN VARIOUS ENVIRONMENTS TO APPLICATION OF DIFFERENT COMMERCIAL WEEDICIDES

by

E. A. Helgeson*

Weedicides used in these trials were: (1) Sodium chlorate, (2) Borascu, (3) Dow 70 percent 2,4-D acid with Na_2CO_3 carrier, (4) Dupont's 50 percent ammonium 2,4-D acetate, (5) Sherwin-Williams 40 percent butyl ester of 2,4-D .

Field trials indicated that: (1) Chlorate applications gave uniform and excellent control throughout the entire range of the trials, both on grassland and fallow; (2) Borax applications resulted in 90-100 percent control on all fallow plots but no control on grassland plots; (3) 2,4-D acid applications showed varied results, differing mostly with rate of application. In general, however, much better control was obtained on fallow than on grassland and decidedly better control on plots in the eastern half of the State than on those in the western portion of the State; (4) 2,4-D ammonium salt, applied at intermediate and high rates, resulted in little or no control on grassland plots and on those plots in the western portion of the State. Control on those plots in the eastern half of the State varied from 55-100 percent; (5) 2,4-D butyl ester, where applied, resulted in no control in grassland plots, and ranged from 40 percent in the west to 99 percent in the east.

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* Experiment conducted cooperatively by L. M. Stahler, Lars Jensen, E. A. Helgeson, and K. L. Blanchard; report submitted by E. A. Helgeson.

THE RELATION OF STAGE OF GROWTH AND RATE OF APPLICATION OF DIFFERENT TYPES OF 2,4-D FORMULATIONS IN ERADICATING FIELD BINDWEED

by

F. L. Timmons

Duplicated spray applications comparing the sodium and triethanolamine salts of 2,4-D at 1, 2, 3, and 4 pounds per acre (acid basis) and the butyl ester of 2,4-D at ½, 1, 2, and 3 pounds per acre (acid basis) were made on bindweed May 5, May 23, and June 14, 1947, at full emergence, bud, and full bloom stages of growth, respectively. Soil moisture was abundant during April, May, and June, but extreme drought conditions prevailed after early July.

Preliminary data on bindweed regrowth recorded four months after the spray treatments in each case show no consistent trend for rate of application or significant differences for types of 2,4-D formulation or stage of growth, except at the bud stage. The sodium salt and the butyl ester were more effective at the bud stage than at full emergence or full bloom but the amine salt was less effective at the bud stage than at other stages except at the heaviest rates. Results with the sodium and amine salts showed a definite trend in favor of heavier rates at the bud stage but the butyl ester was about as effective at ½ pound per acre as at heavier rates. The butyl ester was more effective than the salts at the bud stage, especially at lighter rates but was no more effective than the salts at any rate of application at other stages of growth.

The relation of stage of growth and rate of application of different types of 2,4-D formulations in eradicating field bindweed. NCWCC Uniform Exp. No. I-2, 1947, conducted at the Fort Hays Branch Experiment Station, Hays, Kansas.

Types of 2,4-D product used, trade name in ()	Rate, lbs. of 2,4-D per acre	Percent of bindweed regrowth from treatments made at different stages of growth: (Recorded 4 months after spraying) (1) Complete emergence 5-5-47	First bud 5-23-47	Full bloom 6-14-47
Sodium salt (2,4-Dow Weed Killer, Powdered)	1	10.0	21.2	8.6
	2	9.3	3.9	7.1
	3	12.1	2.1	6.1
	4	7.7	2.7	4.9
	Average	9.8	7.5	6.7
Triethanolamine salt (Tufor 40)	1	7.1	26.8	9.0
	2	7.3	25.1	8.0
	3	8.0	12.0	6.5
	4	11.5	3.3	8.1
	Average	8.5	16.8	7.9
Butyl ester (Weed-no-more)	.5	18.2	2.0	6.8
	1	12.4	1.0	6.6
	2	13.2	.3	12.5
	3	6.7	2.0	18.4
	Average	12.6	1.3	11.1

(1) All data are averages of two replications

THE USE OF 2,4-D IN THE CONTROL OF FIELD BINDWEED

by

F. Bisal

Treatments with Weedone at the rate of 1 and 2 pounds per acre when weeds were in flower were 100 percent effective. No regrowth whatever appeared in 1947. These treatments were carried out on weeds that were established only a few years previously.

Treatments carried out in 1947 were not very satisfactory. However, the poor results may be due to the fact that the area treated was cultivated about four weeks after the spray was applied. Regrowth was sprayed again on September 3 and ultimate results will be observed in 1948.

Results of tests on bindweed

Date treated	Stage	Growth	Chemical	Rate	Temp. F.	Kill leaves, stalks	Kill roots	1947 Results
Aug. 23/46	In flower	Heavy	Weedone	1 & 2 lbs./A & H_2O	85°	100%	100%	No regrowth
Sept. 21/46	In flower	Heavy	Weedone	1 & 2 lbs./A & H_2O	50°	100%	100%	No regrowth
Aug. 10/47 *	Just before flowering	Fairly heavy	Weedone Herbate, Weed-no-more 40	2,3 & 4 lbs./A	76°	100%	Down to 3-4"	Regrowth sprayed Sept.13

* The area was cultivated 4 weeks after treatment.

EFFECT OF 2,4-D TYPE AND DOSAGE ON BINDWEED
IN THE RAPID GROWTH FIRST-BUD STAGE
Noel S. Hanson

An experiment was started on June 3, 1947 in which bindweed, Convolvulus arvensis, was treated at the rapid growth, first-bud stage with amine salt, butyl ester, and sodium salt of 2,4-D at dosages of 1, 2, 3, and 4 pounds per acre. Soil moisture and air temperature at treatment were optimum for rapid growth in the bindweed plants. Each treatment was replicated three times. The first two replications were on moderately high ground and the entire area was in Kentucky bluegrass sod. The third replication was on low ground along a railroad right-of-way.

Results of the experiment noted on September 23, 1947 showed that all original topgrowth had been destroyed and some re-emergence was present. In general, poorer kills were noted along the railroad right-of-way than in the bluegrass sod indicating that either re-emergence was slower from the sod or the competition from the grass supplemented control of bindweed by the herbicide. In no case had the plants in either area produced seed except on check plots and fewer blossoms were present in the grassed area on September 23 than along the railroad bed. Percentage reductions in stand were for the most part as good or better at 1 and 2 pounds per acre than at 3 and 4 pounds per acre. Percentage stand reduction varied from 0 to 99 and was not consistent for type of dosage.

EFFECT OF 2,4-D ON BINDWEED. LINCOLN, NEBRASKA

(Applied 7/3/47 to bindweed in the bud to bloom stage. Foliage of moderate density. Growing conditions optimum.)

2,4-D Type 1/	Dosage lbs./Acre	Original Stand per sq. rod 7/3/47	Remaining per sq. rod 9/23/47	% Reduced Stand 9/23/47	No. Plants Producing Seed 9/23/47	In Blossom 9/23/47
Amine Salt	1	640	20	96.9	0	None
" "	"	740	17	97.7	0	None
" "	"	520	580	0.0	0	Many
Amine Salt	2	580	6	99.0	0	None
" "	"	660	20	97.0	0	None
" "	"	540	130	76.0	0	Trace
Amine Salt	3	420	8	98.1	0	None
" "	"	540	39	92.8	0	None
" "	"	380	340	10.0	0	Trace
Amine Salt	4	540	5	99.0	0	None
" "	"	320	43	13.4	0	None
" "	"	440	270	38.6	0	Few
Butyl Ester	1	1000	46	95.4	0	None
" "	"	580	60	89.6	0	None
" "	"	380	—	----	0	----
Butyl Ester	2	460	31	93.3	0	None
" "	"	420	440	0.0	0	Few
" "	"	480	140	70.8	0	Trace
Butyl Ester	3	380	22	94.3	0	None
" "	"	600	67	88.9	0	None
" "	"	400	40	90.0	0	None
Butyl Ester	4	520	51	90.0	0	None
" "	"	680	410	39.7	0	Few
" "	"	460	59	87.2	0	None
Sodium Salt	1	500	270	46.0	0	None
" "	"	600	110	81.7	0	None
" "	"	380	240	26.8	0	Trace
Sodium Salt	2	340	20	94.1	0	None
" "	"	480	64	86.7	0	None
" "	"	360	80	77.8	0	None
Sodium Salt	3	280	7	97.5	0	None
" "	"	560	8	98.5	0	None
" "	"	560	590	0.0	0	Few
Sodium Salt	4	520	7	98.7	0	None
" "	"	380	15	96.2	0	None
" "	"	300	80	73.4	0	None
Check	0	380	390	0.0	Many	Many
"	"	640	320	50.0	Many	Many
"	"	480	1150	0.0	Many	Many

1/ Original treatment 7/3/47. Retreatment with same type and dosage 9/23/47.

KILLING FIELD BINDWEED WITH 2,4-D

by

H. E. Wood, G. R. Fraser

During 1945-47, 78 plots were devoted to this weed, using all formulations at various concentrations, and at all stages of growth. Although the weed was readily killed back to the ground, anything approaching a permanent kill was obtained only when the plant was in full bloom. The table below gives a comparison of formulations applied to field bindweed in a field of wheat near Winkler. Half-rod plots were sprayed at three dates, 1946, final observations being made August 8, 1947.

Formulation	Acid Concentration	Estimated Reduction in stand in Percent (Date of Treatment & Stage of Growth) June 18 Pre-bud	July 6 Full Bloom	Sept. 13 Post Seeding
Sodium Salt - Dow's	.1%	0	5	15
	.2%	45	80	10
Ester - Dow's	.1%	22	87	15
	.2%	75	90	3
Amine Salt - Stantox	.1%	30	45	5
	.2%	90	87	5
Sodium Chlorate	1 lb. sq. yd.	95	95	-

THE INFLUENCE OF RATE OF APPLICATION OR DOSAGE OF 2,4-D ON ITS EFFECT ON WILD MORNING GLORY (Convolvulus sepium)

by

J. P. Ficht

Plots 3 rods by 40 rods had 2,4-D applied by a Buffalo turbine sprayer. Silty clay soil described by farmers as loose top. Land was worked with a one way disk June 12th, 1947, treated with 2,4-D July 23rd after ample time had been given for regrowth of weeds. Chemicals used were Chipman's (Sodium salt 60 percent), Naugatuk (Amine 30 percent) and Weed-No-More 40 (Ester 32 percent).

Rates with all chemicals were one-half, one, one and one-half and two pounds pure 2,4-D acid per acre. Plots under observation up to October 17th, 1947, showed a quick kill of stems and leaves by Amine and Ester with satisfactory control to October 17th. A very few small plants are developing, but appear to come from fragments of roots which had failed to sprout before spraying.

Sodium salt gave slower kill of stems and leaves and a small percentage of regrowth, particularly on the one-half pound treatment.

The lightest rates of application were as effective as the heavy rates in the Amine and Ester plots but not in the Sodium salt plot.

THE USE OF 2,4-D IN THE CONTROL OF WILD MORNING GLORY
(Convolvulus americanus (Sims) Greene)

by

F. Bisal

Treatments with Weedone and Dow 654 carried out on May 7 and 22, 1946, failed to kill the morning glory completely, as indicated by the 1947 results. The treatments were apparently done too early, since many plants emerged after May 22. Treatments carried out on June 14 and July 16, 1946, after all plants had emerged were 100 percent effective. All the roots were killed to great depth. No regrowth appeared by the end of 1947.

Treatments on May 30, 1947, were not entirely effective and regrowth was sprayed again on August 18. Final results will have to be judged in 1948.

Results of tests on wild morning glory

Date treated	Stage	Growth	Chemical	Rate	Temp. F.	Kill leaves, stalks	Kill roots	1947 results
May 7/46	1-2"	Light, not all emerged	Weedone	1 lb./ac. & 240 gal. H_2O	68°	100%	5-6"	50% regrowth
May 22/46	3"	Heavy	Dow 654	2, 3 & 4 lbs./ac. & H_2O	74°	100%	5-6"	50% regrowth
June 14/46 July 16/46	Some in flower	Heavy	Weedone Standag	1 lb./ac. & 4 gal. oil	70°-82°	100%	100%	No regrowth
May 30/47	Not all plants emerged	Light	Weed-no-more 40	1 lb./ac. & 4 gal. oil	71°	100%	5-6"	Regrowth sprayed Aug. 18, 1947

CONTRIBUTORS

Bisal, F., Dominion Soil Research Laboratory, Exp. Sta., Swift Current, Sask.
Derscheid, Lyle A., Assistant Agronomist, South Dakota Agric. Exp. Sta.
Elder, W. C., Assistant Agronomist, Oklahoma Agricultural Experiment Station
Ficht, J. P., Agronomist, Experimental Station, Swift Current, Sask.
Hanson, Noel S., Assistant Agronomist, Nebraska Experiment Station
Helgeson, E. A., Botany Department, North Dakota Agricultural College
Pavlychenko, T. K., Laboratory of Plant Ecology, University of Saskatchewan
Timmons, F. L., Agronomist, Bureau of Plant Industry, Soil and Agric. Eng.
Woestemeyer, Vernon W., Assistant in Agronomy, Kansas State College
Wood, H. E., Fraser, G. R., The Weeds Commission, Manitoba Department of Agric.

RESULTS OF EXPERIMENTS WITH 2,4-D ON FIELD BINDWEED
Uniform Experiment No. IV.

REGIONAL SUMMARY
by
Lyle A. Derscheid

The study of the abstracts submitted leaves one without any definite trends to discuss. Growing conditions are not known, formulations are not consistant, and little can be said about the stages of growth or the rates of application.

Timmons submitted two abstracts, and Woestemeyer and Derscheid each submitte one. Timmons and Woestemeyer obtained rather poor results from the original treatment and made retreatments. Derscheid had good results on the original treatment and did not retreat.

In one experiment Timmons used 3 pounds of 2,4-D acid on the original treatment and obtained the poorest results from the esters. A retreatment with 2 pounds produced equal results from amines, esters and sodium salts. In a second experiment, Timmons found the esters to be most effective when 2 pounds were used the esters were still superior when a retreatment with 1.3 pounds was made. Woestemeyer reports that the esters and free acid formulations were best when an original treatment of 2 pounds was made; esters and sodium salts were best after retreatments were made. Derscheid could observe no differences as 1 1/3 pounds of all formulations produced 90-95 per cent kills.

The esters are more effective in more cases than any other formulation. These data would lead one to think that perhaps the 3 pound treatment of ester made by Timmons was too much to produce an herbicidal reaction. Data from Uniform Experiment No. I. indicate that this is not the case, however.

ABSTRACTS

A COMPARISON OF THE EFFECTIVENESS OF DIFFERENT
COMMERCIAL PREPARATIONS OF 2,4-D IN ERADICATING BINDWEED
BY
F. L. Timmons

Twenty commercial 2,4-D products were applied as spray at three pounds of 2,4-D per acre on field bindweed in a buffalo grass turf in triplicated treatment made June 5, 1946. Retreatments using the same products in each case at two pounds of 2,4-D per acre were applied October 12, 1946.

Bindweed regrowth from the first treatments as recorded September 30, 1946, showed a range of 1 to 41 per cent of the original stand with no consistent trend for any type of 2,4-D formulation except that the esters were somewhat less effective. Bindweed regrowth averaged 15 per cent for 9 amine salt products; 14 per cent for 7 sodium salt products, and 30 per cent for 2 esters of 2,4-D.

Bindweed regrowth from the second treatment made October 12, 1946, was much reduced for most products when recorded June 12, 1947, but by September 16, 1947, regrowth had increased until it ranged from 2 to 53 percent for the different products. The average regrowth was 22 percent for 9 amine products, 22 percent for 7 sodium salt products, and 28 percent for 2 ester formulations.

Summary of data on the effectiveness of different commercial preparations of 2,4-D in eradicating bindweed. NCWCC Uniform Exp. No. IV, 1946, conducted at the Fort Hays Branch Experiment Station, Hays, Kansas. Original spray applications made June 5, 1946. Retreatments made October, 1946. All data are averages of three replications.

Commercial preparations used, (1)	Types of 2,4-D compounds	Percent of original bindweed that survived: Original treatment made 6/5/46 (recorded 9/30/46)	Retreatments made 10/11/46 Recorded 6/12/47	Retreatments made 10/11/46 Recorded 9/16/47
Chipman 2,4-D Powder	Sodium salt	5	15	12
Weedone	Ethyl ester	41	6	30
Weed-no-more	Butyl ester	19	9	25
Stantox 2,4-D liquid	Amine salt	15	4	40
2,4-D Baker	Sodium salt	13	4	15
Concentrate No. 6	Amine salt	9	15	16
2,4-Dow Liquid	Amine salt	20	6	23
2,4-Dow Powder	Sodium salt	9	4	17
Weedanol M1	Free acid	15	3	38
Tufor 40	Amine salt	7	9	16
DuPont 2,4-D	Ammonium salt	25	7	17
Weedanol M1 Conc.	Amine salt	10	4	17
Weed-Ded	Amine salt	9	10	17
Slayzweed	Sodium salt	38	25	53
Weedicide Hi-Conc.	Amine salt	28	6	21
Stantox 2,4-D Powder	Sodium salt	21	8	31
Weed Tox 40	Amine salt	12	2	27
Weedicide Powder	Sodium salt	1	5	22
Weed Tox Powder	Sodium salt	11	4	2
Dr. Salsbury's 2,4-D	Amine salt	25	9	22
Average of 9 amine salts		15	7	22
Average of 7 sodium salts		14	9	22
Average of 2 esters		30	8	28

(1) All commercial products were applied at the rate of 3 pounds per acre of 2,4-D contained for the original treatments made June 5, 1946, and at 2 pounds of 2,4-D per acre for the retreatments made October 12, 1946.

A COMPARISON OF THE EFFECTIVENESS OF COMMERCIAL PREPARATIONS OF 2,4-D IN ERADICATING FIELD BINDWEED

BY

F. L. Timmons

Twenty different commercial 2,4-D products were applied as sprays and three products applied as dusts, all at the rate of two pounds of 2,4-D per acre in triplicated treatments made October 15, 1946 on a uniform stand and vigorous growth of field bindweed. Retreatments of bindweed regrowth were made at the bud stage June 18, 1947, applying the same product in each case as in the first treatment at 1.3 pounds of 2,4-D per acre.

Bindweed regrowth recorded June 10, 1947 averaged 178 plants per square rod for eight amine products, 172 for seven salt preparation, 74 for three esters of 2,4-D and 343 for three 2,4-D dust formulations as compared with 569 plants per square rod on untreated controls. Some of the amine salt sprays gave better results than others and appeared about as effective as the ester sprays.

Bindweed regrowth from retreatments made June 18, 1947, as recorded October 15, averaged 20 plants per square rod for the amine sprays, 23 for the sodium salt sprays, 3 for the ester sprays, and 13 for the 2,4-D dust treatments. Emergence of surviving bindweed plants probably was not complete, due to dry soil conditions and unsufficient time since the retreatments.

Summary of data on the effectiveness of commercial preparations of 2,4-D and Methoxone in eradicating field bindweed. NCWCC Uniform Exp. No. IV, 1946, conducted at the Fort Hays Branch Exp. Station, Hays, Kansas. All data are averages of three replications of each treatment.

Commercial products of 2,4-D or methoxone used (1)	Types of 2,4-D formulations	Number of bindweed plants per square rod that survived: Original treatment made 10/15/46 Recorded 6/10/47	Retreatments made 6/18/47 Recorded 10/15/47 (2)
Chipman 2,4-D	Sodium salt	260	21
Weedone	Ethyl ester	121	4
Stantox 2,4-D Liquid	Amine salt	113	20
2,4-D Baker	Sodium salt	172	19
Concentrate No. 6	Amine salt	213	32
2,4-Dow Liquid	Amine salt	195	18
2,4-Dow Powder	Sodium salt	99	13
Weed-no-more	Butyl ester	23	-
Tufor 40	Amine salt	71	12
Dow (652) Esteron 20	Methyl ester	87	1
DuPont 2,4-D	Ammonium salt	241	1
Weedanol Ml Concentrate	Morpaline salt	175	3
Weed-Ded	Amine salt	266	44
Slayzweed	Sodium salt	196	65
Weedicide Hi-Conc.	Amine salt	164	16

(continued on next page)

(cont. from Page 3)

Commercial Products used	Types of 2,4-D formulation	Original treatment made 10/15/46	Retreatments made 6/18/47
Stantox 2,4-D Powder	Sodium salt	95	27
Weed Tox 40	Amine salt	202	13
Weedicide Powder	Sodium salt	185	7
Weed Tox Powder	Sodium salt	196	9
Methoxone		189	8
Dr. Salsbury's 2,4-D	Amine salt	202	5
Sherwin-Williams' 2,4-D Dust	Butyl ester	417	4
Weedone Dust	Ethyl ester	198	28
Dow 2,4-D Dust	Sodium salt	415	7
Untreated controls		569	(2)
Average of eight amine salt sprays		178	20
Average of seven sodium salt sprays		172	23
Average of three ester sprays		74	3
Average of three 2,4-D dusts		343	13

(1) All products were applied at the rate of 2 pounds of 2,4-D or methoxone per A in the original treatments made October 15, 1946, and at 1 1/3 pounds of 2,4-D or methoxone per acre in the retreatments made June 18, 1947.

(2) Bindweed was mostly dormant on untreated control plots October 15, 1947, due to dry soil conditions. More moisture was present on the treated plots, but the emergence of surviving bindweed plants may not have been complete.

COMPARISON OF COMMERCIAL PREPARATIONS OF 2,4-D ON FIELD BINDWEED

BY

V. W. Woestemeyer

Fifteen 2,4-D products, including salt, amine, ester and acid types, were tested on duplicate plots; the 2,4-D in all cases being applied in concentrations of 1000 ppm, 1½ gal. per sq. rd. Treatment was made in rapid growth stage with a few buds present in 1946, and repeated at the same stage and in the same manner on these plots in 1947. Counts were made 30, 60 and 90 days after treatment each year. On most plots a few new shoots had begin to appear 60 days after treatment.

The ester and acid types had somewhat greater reductions in stand than did the salts and amines the first year. In 1947 the salt and ester types averaged a slight additional decrease, while there was a slight average increase in plants on the plots receiving the amine and acid types. With an average original count of about 470 bindweed plants per square rod, the average per cent reduction from the 1946 original, in 1946 and 1947 respectively, was for eight salts, 24.98 and 13.20; four amines, 12.70 and 16.97; two esters, 8.45 and 5.95; one acid, 7.80 and 9.70—counts taken 90 days after treatment. The composite average reduction for 1946 and 1947 respectively was 13.02 and 13.01.

The effect of the ester and acid types was observed more readily after application than that of salts and amines.

Uniform Experiment IV, 1946
Canton, Kansas
Comparison of Commercial Preparations of 2,4-D on Field Bindweed in Rapid Growth Stage[1]

Product Used	% 2,4-D Acid	Type	Plant counts 90 days[2] after treatment			% original number surviving 90 days after treatment	
			Original	1946	1947	1946	1947
Chipman 2,4-Dow Weed Killer Powder	60	Sodium salt	488	58	37	11.9	7.6
Slayzweed	70	" "	495	66	40	13.3	8.1
Dedweed	70	" "	495	83	56	16.4	11.3
DuPont	70	" "	495	77	41	15.3	8.3
Dow A-506 Weedicide Tablets	76	" "	495	80	68	16.1	13.7
DuPont IN-6065-A-7	70	" "	365	86	53	18.8	14.5
Tufor 40	40	Ammonium Salt	463	82	154	17.7	33.3
2,4-Dow weed Killer Liquid	10	Triethanol-amine salt	483	49	43	10.3	8.9
Rid-C-Weed	40	" "	463	43	47	9.4	10.2
Purina	20	" "	470	65	78	13.9	16.6
Weedone	10	" "	468	78	152	16.3	32.5
Weed-no-more 40	20	" "	458	52	39	11.2	8.5
Weedanol M1	9.6	Ethyl Ester	488	47	31	8.6	6.4
COMPOSITE AVERAGE	32	Butyl Ester	456	38	25	8.3	5.5
	16.6	2,4-D acid in Consolvent	475	36	46	7.8	9.7
			470.5	62.7	60.7	13.02	13.01

1. All applications 1000 ppm, 1½ gal. per sq. rd.
2. All plant counts are averages of duplicate plots.

A COMPARISON OF THE EFFECTIVENESS OF DIFFERENT COMMERCIAL PREPARATIONS OF 2,4-D IN ERADICATING BINDWEED

by

Lyle A. Derscheid*

Fourteen commercial 2,4-D products (12 sprays and 2 dusts) were compared in duplicate on undisturbed bindweed at the rate of 1 1/3 and 2 2/3 pounds of 2,4-D acid equivalent to the acre. Applications were made in 1946 when the bindweed was in full bloom; stand counts were made during the summer of 1947.

* Experiment Conducted in cooperation with Dr. L. M. Stahler.

The treatments were made when there was an abundance of soil moisture and warm temperatures. All treatments eliminated between 90 and 95 per cent of the original plants; consequently, one chemical appears to be as good as another under these conditions.

The following table lists the chemicals that were used:

Name of Chemical	Type of Chemical
1. Chipman 2,4-D powder	sodium salt
2. 2,4-Dow powder	sodium salt
3. Slazweed	sodium salt
4. Weedonal Ml	free acid in carrier
5. Weedone	ethyl ester
6. Weed-no-more	butyl ester
7. 2,4-Dow Weed Killer	methyl ester
8. Stantox	triethanol amine
9. Tufor 40	triethanol amine
10. Weedicide	diethanol amine
11. Weed Tox	triethanol amine
12. 2,4-Dow Liquid	alkanol amine
13. Dow dust	sodium salt dust
14. Weedone dust	ethyl ester dust

CONTRIBUTORS

Derscheid, Lyle A., Assistant Agronomist, South Dakota Agricultural Experiment Station.
Timmons, F. L., Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, Cooperating with the Fort Hays Branch of Kansas Agricultural Experiment Station.
Woestemeyer, V. W., Assistant in Agronomy, Kansas State College.

Results of Uniform Experiments with 2,4-D on Canada thistle cirsium arvense (h) Scop.

Regional Summary

A. L. Bakke, Iowa Agricultural Experiment Station, Ames Iowa

From the various experimental reports on the destruction of Canada thistle with 2,4-D, it is clear that the Canada thistle plant is in the resistant category. No single treatment with 2,4-D, not even 10,000 parts per million will eradicate Canada thistle. The concentration generally recommended is 1500-2000 p.p.m. wherever it is preferable to get a complete distruction of the above-ground parts over some injury to the associated crop. There is a decided advantage in getting at least two sprayings of 2,4-D during the season, three applications if possible. The results so far show that 2,4-D applications are more effective when applied at the early bud stage. Mowing done at the bud stage followed by two applications the next year have reduced old stands of Canada thistle more than 90 per cent. The ester formulations in all cases have been the most effective. Applications made during the early bud stage will stop growing activities-seed will not be formed. Dusts of 2,4-D can be effectively used in treating Canada thistle patches and individual plants in pastures, grain, and corn fields. Where soil sterilization is not an object sodium chlorate can be used.

Abstracts

SPRAYING CANADA THISTLE WITH 2,4-D MATERIALS

R. F. Fuelleman and F. W. Slife, Illinois Agr. Experiment Station-Urbana

A series of small plots were located on the 4-H Park area of the Allerton tract. A heavy infestation of Canada thistle had been previously covering an area 150 x 200 feet. This infestation seems to be restricted, and subsequent examination disclosed no seed.

The plots were eight by sixteen feet in area. Table 1 indicates the treatments used.

Table 1. Materials Used and Other Data Noted on May 13, 1947
Allerton Park Tract
Temperature 70°F., Wind SW. 15-20 M.P.H., Humidity 78 per cent

Plot	Treatment	Quantity and Concentration per plot	Average number of Thistle shoots per square foot
1	Esterone 44	1/10 of 1 %, 1 gal.	6
2	Chipmans 2,4-D	1/10 of 1 %, 1 gal.	7
3	Dow 510	1/10 of 1 %, 1 gal.	11
4	Chipmans 2,4-D	1/10 of 1 %, 1 gal.	13
5	None	----------	16
6	Dow 510	1/10 of 1 %, 1 gal.	14
7	Karmex (Dupont)	1/10 of 1 %, 1 gal.	14
8	None	----------	13
9	Weed-No-More 40	1/10 of 1 %, 1 gal.	12
10	Karmex	1/10 of 1 %, 1 gal.	25
11	Esterone 44	1/10 of 1 %, 1 gal.	19
12	Weed-No-More 40	1/10 of 1 %, 1 gal.	23

All materials were applied in water solution or mixture with a hand sprayer of the knapsack type and as stated in uniform concentration. Action of the ester formulations was more rapid than the mineral salt compounds, however, on May 27 the results appeared to be similar. All green top growth was dead. Check and unsprayed areas had thistles 20 inches tall.

On July 2 some re-growth had appeared on all sprayed plots and had attained a height of six inches. Unsprayed areas were 36 inches tall and in blossom. Plot 10 was re-treated with Karmex. Plot 11 was re-treated with one gallon of two-tenths per cent of one per cent esterone. Plot 12 was re-treated with two-tenths of one per cent Weed-No-More, and a thirteenth plot previously untreated was given the same treatment as plot 12. At the same time various other weeds nearby were sprayed. About ten days later the thistle area was mowed including sprayed plots, although where treated the thistles were too short to be affected. Some advantage probably occurred to the untreated plots. In August the mowed thistles were burned as they lay on the ground. This probably lessened the number of shoots on the checked plots.

On October 3 counts were made of the number of thistles shoots present. These data are shown in Table 11.

Table 11. Numbers of Thistle Shoots on October 3, 1947
Allerton Park Tract

Plot	Treatment	Date	Average Number of thistle shoots per Square foot
1	Esterone 44	5-13-47	1.6
2	Chipman's 2,4-D	5-13-47	1.4
3	Dow 510	5-13-47	1.6
4	Chipman's 2,4-D	5-13-47	2.8
5	None	5-13-47	11.2
6	Dow 510	5-13-47	0.6
7	Karmex (DuPont)	5-13-47	2.0
8	None	5-13-47	10.4
9	Weed-No-More 40	5-13-47	2.4
10	Karmex	5-13-47, also 7-2	1.4
11	Esterone 44	5-13-47, also 7-2	0.8
12	Weed-No-More 40	5-13-47, also 7-2	0.4
13	Weed-No-More 40	only on 7-2	5.0*

* These were mowed and subsequently burned. Probably accounting for a good part of the destruction of the shoots.

It is interesting to note that where thistles were sprayed with 2,4-D materials, no flower heads were formed unless present at the time of spraying. The important point here is that spraying prevented flowering. The reduction in vigor of the plants may have some bearing on their ability to grow in 1948.

A fall spraying within the month of October will be made to ascertain the effect on emergence in 1948.

Blossoming plants are prevented from maturing, but the cost of using 2,4-D sprays on a heavy stand of Canada thistles would be relatively high if any degree to control were achieved.

On October 17, plots 10, 11, 12, and 13 were sprayed with one pint of Weed-No-More 40 to one gallon of water, applied at the rate of two gallons per acre with a Sherwin-Williams mist sprayer. The temperature was 80°F., with very little wind blowing. In addition, a large area, untreated except for mowing, was sprayed. Another point not previously mentioned was the presence of large numbers of plants apparently affected by disease or insects.

Control of Canada Thistle with 2,4-D

A. L. Bakke, Iowa Agricultural Experiment Station, Ames

A heavy stand of Canada thistle was treated with the same amount of 2,4-D in 1945 and 1946. Two sprayings were made each year, the first at the early bud stage and the second in September. In 1947 the thistles were allowed to grow in the brome until the first part of July when the area was mowed. Counts of the number of thistles remaining in each square rod plots were then made in September 1947 when the whole area was sprayed with Weedone at the rate of 1000 ppm. The results were as follows: Du Pont #1-15 plants, Weedone 20, Du Pont #4 - 23, Du Pont #2 - 30, Chipman 35, Du Pont #3 - 43, Dow A510 - 44, Carbonax 56, Ammate 4, Sodium Chlorate, 0 after the first year. It would then appear as if the eradication of Canada Thistle with 2,4-D is generally a two year proposition, at least.

Spraying of 2,4-D on Canada thistle in pasture land in nothern Iowa generally produced, from two sprayings in one season, a reduction in stand of 70 per cent. Mowing prior to blossoming followed by one spraying in September reduced the stand of Canada thistle 40 - 50 per cent. Two sprayings of 2,4-D following the fall application of the previous year reduced the stand about 95 per cent. The ester formulations gave the best results.

Canada thistle growing in oats was sprayed with one of the ester formulations of 2,4-D when the oats were in the milk stage and again in the stubble. There was a reduction in the stand at least 90 per cent.

A heavy stand of Canada thistle was sprayed with an ester formulation in early July when the plants were in the bud stage. About 4 weeks after spraying the infested area was plowed. Up to November no aerial growth had been found.

Killing Canada Thistle (Cirsium arvense) with 2,4-D

H. E. Wood and G. R. Fraser
The Weeds Commission, Manitoba Department of Agriculture

During 1945-47, 64 trial plots of this weed were knapsack sprayed with all formulations, 1 to 2 pounds acid per acre, at all stages of growth. In no instance was a permanent kill obtained. This weed was "killed" back to the ground rather more readily than was sow thistle. Without exception, regrowth the following year was equally as rank and vigorous as on check plots. As with sow thistle, control of this weed in growing crops can be obtained with moderately light concentrations applied at the prebud stage. Seed-setting is eliminated and the danger of dissemination by wind is no longer a threat to clean areas.

2,4-D on Canada Thistle

C. J. Willard
The Ohio Agricultural Experiment Station in cooperation with the Dow Chemical Company.

Between 200 and 300 square-rod plots of Canada thistle have been experimentally treated with various formulations of 2,4-D from one to five times in 1945, 1946, and 1947. Unfortunately the 1945 plots could not be continued in later years so we have records of only two years' treatment on the same plots. No treatment, even up to 20 pounds per acre (10,000 ppm) has killed Canada thistle roots at one treatment. Any formulation of 2,4-D at 2, or at the most, 3, pounds acid equivalent per acre (1000-1500 ppm) has killed Canada thistle tops. The effect of 2,4-D on Canada thistle is a more effective method of mowing. Sprouts do not come back as quickly when the tops are killed by 2,4-D as they do when they are mowed, nor are the sprouts as vigorous. Nevertheless, there are still sprouts on all plots of Canada thistle that were treated 2 and 3 times in 1946 and twice in 1947. The general appearance of these plots is one of complete eradication and it is probable (though prediction is dangerous) that two treatments in 1948 will complete eradicating the patch. At all events the area has furnished excellent pasture in 1947 where thistles were so dense that it was not pastured at all earlier. The most effective date for the first application on Canada thistles was May 30th when the thistles were in very early bud. Treatments throughout June continued to be reasonably favorable. This was in a wet season. A dry season might have shown different results. Earlier treatments, while effective, resulted in earlier and stronger resprouting than late May and early June treatments. Sprouts appeared in July following all of these treatments. The plots were divided in an attempt to discover the best time for retreatment. This test was not conclusive and the differences were not great. However, those plots which received three treatments in 1946 showed much fewer and weaker sprouts in 1947 than those which received only two treatments. Our recommendations for Canada thistle would be to apply three treatments the first year using 2 pounds acid equivalent per acre of the esters or 3 pounds per acre of the sodium or triethanolamine salts, making the first treatment in bud to early bloom, the second when the sprouts are 4 to 6 inches high in mid-summer, and the third when the sprouts have reappeared in considerable numbers in September. Then apply two treatments each year until eradication is complete.

The Use of 2,4-D Dusts on Canada Thistle and Bindweed.

C. J. Willard and D. F. Beard.
The Ohio Agricultural Experiment Station and The Ohio State University in cooperation with the Dow Chemical Company.

Though concentrated sprays will tend to replace dusts, there may be a place for dusts in treating Canada thistle and field bindweed in crops because of the much greater penetrating power of the dust. 2,4-D dust has been quite effective in killing the tops of Canada thistles and the roots and tops of field bindweed. Dusts have been satisfactorily used on Canada thistles in pastures, (Canada thistles in a pasture on the University farm have been nearly eradicated in two years by dust treatments only.) in oats after they have headed, (A man with a duster can walk into the field and dust patches of Canada thistle and bindweed which are then obvious from the bloom and give them a thorough treatment, which would be more difficult to do with concentrated spray.) in corn fields after the corn is laid by, and along fence rows where the growth is too tall for the satisfactory use of concentrated spray. Under the most favorable conditions dusts have been equal to sprays in effectiveness but they have not been equally effective per unit of 2,4-D as an average.

ERADICATION OF CANADA THISTLE WITH 2,4-DICHLOROPHENOXYACETIC ACID.

by T. K. Pavlychenko
Laboratory of Plant Ecology
University of Saskatchewan, Saskatoon

On August 16th, 1946 Canada thistles were treated with Ethyl and Methyl esters, amine salt and sodium salt of 2,4-D at the rates of 1, 1½ and 2 lbs. in 80 gallons of water per acre applied with the Fargo boom sprayer. The infestation was solid (400 to 700 plants to a sq. yd.) over an area of 30 acres of drained slough with very deep silt loam. The weeds were in the late bloom stage 3 to 4 feet high. The plots (duplicate) 16 by 200 ft. in size were separated by control plots of the same size. The records on weeds were taken one month after spraying and before the killing fall frost in 1946, and on August 16, 1947. The plots and controls were sown to barley in 1947 and yield records determined.

Results: Average percentages from eight randomized one sq. yd. quadrats taken in the late fall of 1946 and on August 16, 1947, and the grain yields in bus/acre were determined as follows:

AVERAGE PER CENT REDUCTION OF ORIGINAL STAND

	Ester						Salts					
Chemical	Ethyl			Methyl			Amine			Sodium		
	.1	.15	.2	.1	.15	.2	.1	.15	.2	.1	.15	.2
Fall 1946												
Canada thistle	27	45	57	28	50	63	2	5	8	0	0	0
Fall 1947												
Canada thistle	66	81	93	83	94	96	3	7	14	1	3	5
Barley yield bus./acre												
Controls		0			0			0			0	
Treated plots		56.2			57			3.5			1.2	

The influence of rate of application or dosage of 2,4-D on its effect on Canada Thistle (Cirsium arvense.)

By H. A. Friesen,
Assistant in Field Husbandry.
Dominion Experimental Station-Scott, Sask

ABSTRACT

On the basis of our 1946 and 1947 results, 2,4-D applied at the rate of twenty-four and thirty-two ounces per acre holds considerable promise as a method of combating Canada Thistle in this area. Plots so treated in 1946 showed a reduction in stand of eighty to ninety per cent, in 1947. Very similar results were observed four months after treatment of Canada thistle in the bud stage in 1947.

Complete killing of the roots and rootstocks as a result of 2,4-D was not observed in 1946 or in 1947. However, in both years the ester was found to be more effective than either the amine or the sodium salt types. The difference in effectiveness between the twenty-four and thirty-two ounce per acre rates was negligable within any one type. The difference between the sixteen and twenty-four ounce per acre rates was considerable, especially with the amine and sodium salts, where the twenty-four ounce rate gave twelve and eighteen per cent higher kills, respectively.

Treating Canada Thistle at the full emerged stage resulted in poorer kills of both the top growth and the roots. This was particularly true of the amine and sodium salt types.

The test was carried on in a field seeded down to brome with a nurse crop of oats. While some disfiguration of the oats was observed, the yield was actually enhanced by virtue of the checks being so polluted with Canada Thistle that large portions of them could not be harvested.

Experiment I-3 The influence of rate of application or dosage of 2,4-D on its effect on Canada Thistle (Cirsium arvense.)

Stage of growth	Date treated	Type of 2,4-D used	Dosage	Estimated kill of top-growth in per cent				Estimated regrowth per cent			
				30 days	60 days	90 days	120 days	30 days	60 days	90 days	120 days
Full Emergence	June 7	sodium salt (Herbate)	8 oz	40	60	60	62	0	0	15	38
			16 oz	52	65	65	65	0	0	12	31
			24 oz	70	70	70	71	0	0	4	28
			32 oz	70	72	72	72	0	0	5	26
		Amine salt (Naugatuck)	8 oz	42	60	60	68	0	0	12	30
			16 oz	62	68	68	70	0	0	8	25
			24 oz	76	78	78	78	0	0	3	22
			32 oz	78	81	81	81	0	0	3	20
		Ester (Weed-No-More 40)	8 oz	60	73	73	73	0	0	8	22
			16 oz	73	75	75	78	0	0	8	22
			24 oz	82	90	91	91	0	0	2	15
			32 oz	86	91	91	94	0	0	2	12
First Bud	June 28	sodium salt (Herbrate)	8 oz	62	65	66	68	0	0	8	27
			16 oz	66	68	70	70	0	0	8	25
			24 oz	74	80	83	88	0	0	5	20
			32 oz	80	85	87	90	0	0	6	18
		Amine salt (Naugatuck)	8 oz	68	70	72	75	0	0	3	21
			16 oz	71	71	76	78	0	0	2	18
			24 oz	80	84	88	90	0	0	0	14
			32 oz	88	90	90	91	0	0	0	10
		Ester (Weed-No-More 40)	8 oz	79	80	82	85	0	0	0	16
			16 oz	83	83	84	86	0	0	0	12
			24 oz	89	90	90	94	0	0	0	6
			32 oz	95	95	95	96	0	0	0	4

THE USE OF 2,4-D IN THE CONTROL OF CANADA THISTLE

(Circium arvense)

F. Bisal

Dominion Soil Research Laboratory,
Swift Current, Sask.

Canada thistles treated with 2, 3 and 4 pounds per acre of Dowo 510 on May 28, 1946, died down to a depth of 4 or 5 inches. About 50 per cent of the plants produced regrowth within a month. The regrowth was sprayed with Weedone at 2, 3 and 4 pounds per acre. This did not kill the plants completely, though a marked reduction in stand was obtained. On Sept. 11, 1947, about 30 per cent of the plants had a live root system from 6 inches down. A third treatment might be necessary to kill the remaining plants completely.

The results on plots initially sprayed in 1947 were about the same. It was necessary to respray plots that were sprayed on July 8, 1947, but the ultimate results from this treatment cannot be determined until some time in 1948.

RESULTS OF TESTS ON CANADA THISTLE

DATE TREATED	STAGE	GROWTH	CHEMICAL	RATE	TEMP. F.	KILL LEAVES-STALKS	KILL ROOTS	1946 RESULTS	1947 RESULTS
MAY 28/46	4-5"	HEAVY	DOWE 510	2,3 & 4 LBS./AC.	83°	100%	4-5"	50% REDUCTION	-
RETREATED JUNE 20/46	4-5"	SICKLY	WEEDONE	2,3, & 4 LBS./AC.	83°	100%	4-5"	75% REDUCTION	LIVE ROOTS FOR 30% OF THE PLANTS
JULY 8/47	BUDDING	HEAVY	WEED-NO-MORE 40	2 LBS/AC. & OIL	92°	100%	4-5"	-	30% REGROWTH
RETREATED AUG. 21/47	BUDDING	LIGHT	WEED-NO-MORE 40	2 LBS./AC. & OIL	92°	100%	4-5"	-	?

Use of concentrated 2,4-D sprays in the control of Canada thistles.

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

In 1946 the effectiveness of various quantities of water as a vehicle for 2,4-D was studied using Canada thistles as the test plant. Replicated plots were treated with 240, 120 and 60 gallons of spray, applications in each spray rate containing 1, 2 and 4 pounds of 2,4-D acid equivalent as the sodium salt. No significant differences in top or leaf kill were obtained for the different spray rates. The higher rates of 2,4-D application significantly increased the speed and completeness of leaf and top kill. In 1947 shoot counts were obtained on the treated plots. No significant differences in shoot reduction were obtained for the different spray rates. The 1, 2 and 4 pound applications gave average shoot reductions of 66, 93 and 96 per cent respectively. The 1 pound rate was significantly lower than the other two.

A similar experiment was started in 1947 using 120, 60, 30 and 15 gallon per acre applications, all containing 1 pound acre of 2,4-D acid

equivalent as the sodium salt. Thistle injury indexes obtained 7 days after treatment showed no significant differences. Later observations indicated that top growth kill was nearly equal on all treated plots.

Effect of date and rate of 2,4-D application on the control of Canada thistle

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

Replicated one-half square rod plots of Canada thistles were treated at the emergence, pre-bud, bloom, regrowth and pre-frost stages of growth with 1, 2, 3 and 4 pounds per acre of 2,4-D acid equivalent as the sodium salt. Checks and plots sprayed at the regrowth and pre-frost dates were mowed when the thistles were in full bloom. Spray applications were made in 1945 and 1946. Thistle shoot counts were obtained before the sprays were applied in 1945 and in the spring of 1946 and 1947.

Over the two year period significantly better control was given by the pre-bud application. Reductions in stand obtained in 1947 were 66, 88, 68 and 54 per cent for the emergence, pre-bud, bloom and regrowth applications. Plots given the pre-frost application showed an increase in shoot number 49 per cent rather than a decrease. During this 2 year period the shoot count on the check plots declined 27 per cent.

The 1, 2, 3 and 4 pound rates of application gave reductions of 53, 70, 71 and 81 per cent respectively. The 1 pound rate is significantly lower than the others.

Relative value of spring and fall 2,4-D treatments in controlling Canada thistles

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

In 1946 a large infestation of Canada thistles was divided into plots 20 by 40 feet. Thistle shoot counts were obtained soon after complete emergence. Certain plots were treated with 2 pounds and others with 4 pounds of 2,4-D acid equivalent as the sodium salt, using a power sprayer when the thistles reached the prebud stage of development. The untreated plots were mowed and certain of them were treated with the 2 and 4 pounds of 2,4-D when the thistle regrowth was about 8 inches high. Certain of the previously treated plots were retreated as well, although growth was not abundant. Shoot counts were made in the spring of 1947 to determine the extent of the injury to the thistles. Statistical analysis of the data was impossible but all treatments were in duplicate and a number in quadruplicate.

The shoot numbers on untreated plots mowed at the blossom stage increased an average of 54 per cent from 1946 to 1947. The 2 and 4 pounds spring treatments reduced shoot numbers 68 and 34 per cent respectively. Two and 4 pound applications in the fall reduced shoot growth 25 and 44 per cent respectively. Two and 4 pound applications in both spring and fall resulted in shoot reductions of 83 and 86 per cent the following year. Wherever appreciable regrowth occurs following spring application retreatment in the fall seems advisable.

Hoary Cress

Results of Uniform Experiment I With 2,4-D on Hoary Cress

Regional Summary

Prepared by J. W. Zahnley

Results of experiments with 2,4-D for the control of hoary cress were reported from four locations in Canada and two in the United States. The reports submitted seem to indicate certain trends that merit consideration in an attempt to summarize the results of these experiments. Five of the six reports included in this summary indicate that the esters are more effective than the salts when used at comparable rates of 2,4-D. Quicker action on the weeds, more complete kill of top growth and slower recovery were characteristic results of the esters when comparable rates of salts and esters were used. Two of the reports show that to obtain comparable results, 2,4-D in the form of salts must be applied at a much higher rate than in the esters.

Stage of growth of the weeds is an important factor in determining the effectiveness of 2,4-D. Fall applications appear to be more effective than spring. When spring applications are made, better results are usually obtained when the weeds are in the bud stage. In no case were good kills reported from treatment at full bloom stage or later. Treatment given not later than full bloom at a rate of one pound per acre, however, prevented the production of viable seed in one experiment.

A study of the following abstracts would seem to justify the following deductions: (1) Hoary cress is moderately resistant to 2,4-D and relatively heavy applications of two to four pounds per acre seem to be desirable. (2) The esters are more effective than the salts or amines. (3) Results of treatments should not be judged too soon. Spring applications should not be evaluated before fall nor fall treatments until well along the following spring. (4) Seed production can be prevented and in time the weed can be eradicated by the proper use of 2,4-D. (5) Applications should be made in the fall or in the spring before bloom stage. Fall treatments appear to be the most effective. (6) Eradication can be accomplished only by repeating the treatments over a period of several seasons.

The Effectiveness of Different Types of 2,4-D Formulations at Different Rates of Application in Eradicating Hoary Cress (NCWCC Uniform Exp. No. I-3, 1946)

F. L. Timmons (1)

Triplicated spray applications on hoary cress (Lepidium draba) were made April 12, 1946, comparing the sodium salt, triethanolamine salt, and ethyl ester of 2,4-D at 2, 3 and 4 pounds of 2,4-D per acre and the butyl ester of 2,4-D at 2, 3 and 4 pounds of ester per acre (1.6, 2.4 and 3.2 pounds of 2,4-D). The hoary cress was in bud to early bloom when sprayed. The spray treatments were repeated on the same plots October 22, 1946 on hoary cress regrowth which was in the rosette stage and making vigorous growth.

The regrowth of hoary cress from the first treatments averaged 17, 31, 83 and 93 percent, respectively, for the ethyl ester, butyl ester, sodium salt and triethanolamine salt with the heavier rates of application giving better results than lighter rates in the case of the esters. Results from the retreatments made on fall regrowth were much more satisfactory with all four chemicals. The percentages of regrowth from retreatments at 3 pounds per acre were 3.4, 9.5, 16.8 and 17.1, respectively, for the ethyl ester, butyl ester, sodium salt and amine salt. The percentages of regrowth from treatments at 4 pounds per acre were 1.2, 8.3, 5.0 and 12.6, respectively, for the same chemicals. The salts of 2,4-D were entirely ineffective on hoary cress in the spring applications and gave comparable results with the esters in the fall applications only when applied at rates twice as great. See Table 1.

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(1) Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station.

Effect of Different Dosages of Butyl Ester of 2,4-D on Hoary Cress

Noel S. Hanson (1)

An experiment was started on May 8, 1946 in which four different dosages of butyl ester were applied to hoary cress, Lepidium draba, when the plants were in the rapid-growth, first-bud stage. Dosages were at 1, 2, 3 and 4 pounds per square rod. The plots were replicated three times. Observations on May 31, 1947 showed an average reduction in stand of 99, 96, 98 and 98 percent for the dosages of 1, 2, 3 and 4 pounds of acid equivalent, respectively. Four plots showed complete reduction in stand with no plants visible. Later observations showed no recovery, indicating complete eradication.

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(1) Assistant Agronomist, Nebraska Experiment Station, Lincoln, Nebraska.

Table 1. Summary of data on the relation of rate of applying different types of 2,4-D formulations to their effectiveness in eradicating hoary cress. NCWCC Uniform Exp. No. I-3, 1946 conducted at Hays, Kansas. All data are averages of three replications. F. L. Timmons.

Type of 2,4-D formulations used. Trade name given in ()	Rates of application lbs. of 2,4-D per A.		Percent regrowth of original stand of hoary cress	
	4-12-46	10-22-46	10-22-46	5-22-47
Sodium salt (2,4-D Baker)	2	6	84	9.1
	3	3	97	16.8
	4	4	69	12.6
	Average		83	12.8
Butyl ester (Weed-no-more)	2*	2*	43	20.2
	3*	3*	19	9.5
	4*	4*	32	8.3
	Average		31	12.7
Triethanolamine (Stantox 2,4-D Liquid)	2	6	78	7.0
	3	3	94	17.1
	4	4	106	5.0
	Average		93	9.7
Ethyl ester (Weedone)	2	2	21	6.9
	3	3	17	3.4
	4	4	12	1.2
	Average		17	3.8

* Weight of butyl ester of 2,4-D which contains 80 percent 2,4-D equivalent. Weed-no-more was compared with other products on the ester basis at the request of the manufacturer.

The Effect of Different Types of 2,4-D and Rates of Application on Hoary Cress in Grass Sod and in Cultivated Land

J. W. Zahnley (2)

Hoary cress in bluegrass and in bromegrass sod and in cultivated land was treated with different formulations and rates of 2,4-D. Four applications have been made in the grass sod May and September 1945, April 1946, and May 1947. Sodium salts at rates of 1.92, 2.88, 3.88 and 4.32 pounds of 2,4-D per acre showed progressively greater effectiveness as the rate increased to 4.32 pounds per acre for the first two applications. Reduction in stand by 4.32 pounds of sodium salt was practically the same as with 1.92 pounds of butyl ester after three applications of each. The difference in effectiveness of the different rates of sodium salt and the superiority of the esters became less pronounced after the second treatment. Fall applications of both sodium salt and ester were more effective than those made in the spring. For the first three treatments the sodium salts reduced the stand 94 percent and the esters 97 percent. The fourth treatment, May 14, 1947, consisted of a uniform application of butyl ester to one series and isopropyl ester to the other. On October 22, 1947 the hoary cress in five of the 14 plots in bromegrass, and three of the 14 in bluegrass, appeared to be completely eradicated, and only a trace of plants were found on the remaining plots.

Duplicate treatments were made on hoary cress in cultivated land May 3, 1946 and October 1, 1946, using three types of 2,4-D formulations and methoxone. On May 2, 1947 the reduction in percent stand of hoary cress by each type was esters 90, triethanol amine 63, sodium salt 54 and methoxone 75. All plots were treated with the ester May 14, 1947. On October 15 the regrowth consisted of only 9 plants found on one plot originally treated with triethanol amine. No regrowth appeared on any of the other plots. This low count may be due in part to the extreme drouth in late summer and fall which doubtless retarded regrowth. It appears however that hoary cress can be eradicated by repeated treatments with 2,4-D.

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(2) Agronomist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The Influence of Stage of Growth, Formulation of 2,4-D and Concentration of Application on Lens-podded Hoary Cress (Cardaria draba var. repens (Schrenk) O. E. Schulz) (Uniform Experiment I-1)

J. J. Sexsmith (3)

Tests, in duplicate, conducted at Dalroy Substation 16 miles east of Calgary, Alberta, were set up in 1946 using four formulations of 2,4-D and four concentrations of application, at five growth stages. Retreatments were given to all plots of one replicate in 1947, using the same rates as original treatments, when the cress was between the bud and full bloom stages of growth.

Top growth kills of from 5 percent to 100 percent resulted from the single treatment, the greater kills resulting from the ester and the amine salt at 3 and 4 pounds per acre. Amount of regrowth varied greatly, being as low as 1 to 3 percent for the amine and ester at the higher concentrations. Production of viable seed was prevented by treatments given not later than full bloom at a rate of one pound per acre. Best results were from treatments made at the bud stage. Plots that had received the single treatment (1946) were seemingly back to the condition of untreated areas by October 1947. Retreated plots were showing some effects of the treatments by October 1947, but differences due to the various rates and formulations were not very marked.

Under conditions similar to those prevailing in these tests, it seems doubtful if 2,4-D will kill lens-podded hoary cress. However 2,4-D may prove useful, in conjunction with cultural and cropping practices, in bringing about complete eradication.

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(3) Experimental Farm Service, Dominion Department of Agriculture, Experimental Station, Lethbridge, Alberta.

Killing Perennial Weeds With 2,4-D, 1947
Hoary Cress - Lepidium Draba

D. A. Brown (4)

Seventy-seven quarter square rod plots were used and treatments replicated. Stages at which treatments were applied: (a) full emergence May 16, (b) pre-bud May 29, full bloom June 20, fall rosette September 26. One range of plots was used for repeat sprayings. Formulations used were ester, amine salt and sodium salt, at concentrations of 1 and 2 pounds pure acid per acre in 120 U.S. gallons water. Application was made with a knapsack sprayer.

Counts of stand in number of plants were made on permanently staked squares in each plot and percentage stand calculated on the basis of plants per square foot. Results were shown as percentage reduction of original stand plus regrowth. Infestation on the plot area was uniform and dense. Few other weeds appeared until a heavy infestation of wild buckwheat (Polygonum convolvulus) occurred late in the season.

Ester gave more rapid kills of top growth. Amine was intermediate and sodium slow in effect but at last reading October 6, sodium appeared to have given equally as good results as the others. Top growth was well killed to the ground at all stages of growth with a slight preference favoring the full bloom stage. Reductions in stand of top growth as at October 6 ranged as follows: Ester 2 pounds acid per acre 82 to 90 percent; Amine 60 to 90 and sodium 30 to 92. Ester 1 pound 65 to 100; Amine 40 to 100; sodium 20 to 90.

On the plots receiving repeated sprayings full sprayings were done May 16 and 29 and June 20. Spot spraying of plants remaining were done in September and October. All formulations were equally effective, there being no plants showing above ground in October at the 2-pound concentration and about five percent at 1 pound. Diggings in October showed little killing of roots in the single sprayings but a high percentage of root killing in the repeatedly sprayed plots. Results are shown in Table 2.

(4) Assistant Superintendant, Dominion Experimental Farm, Brandon, Manitoba.

The Use of 2,4-D in the Control of Hoary Cress
(Lepidium Draba L.)

F. Bisal (5)

Plots sprayed with Weedone in 1946 produced no regrowth that season, and it was expected the weed would die out completely. A vigorous regrowth appeared in 1947, however.

Plots treated with Weed-no-more 40 in 1947 produced a sickly regrowth within a month. These were retreated on July 10. The tops and roots down to 4-inch depth were killed out completely, though roots remained healthy below this depth. The healthy roots began to produce numerous buds late in the season and it is more than likely the weeds will emerge and grow in 1948. Results are shown in Table 3.

(5) Dominion Soil Research Laboratory, Swift Current, Saskatchewan.

The Influence of Stage of Growth, Fromulation of 2,4-D and Concentration of Application (Dosage) on Perennial Weeds. (Uniform Experiment I-1)

H. A. Friesen (6)

All formulations, regardless of concentration, resulted in almost complete killing of the top growth of hoary cress when the spraying was done at the first bud, or rapidly growing stage. At the fully emerged stage, very good kills of the top growth resulted from the use of the ester at all concentrations, but the amine and sodium salt gave good kills only at the higher concentrations. All formulations, except the ester at the two pound per acre rate, resulted in poor kills at the flowering stage. Hoary cress, treated in the fully emerged and first bud stages failed to set seed; however, when treated at the full flowering stage all unaffected plants, as shown in Table 4, set seed.

Root killing did not appear to be extensive especially when the treatments were made in the fully emerged or flowering stages. At these stages regrowth was in evidence some six weeks after treatment, and twelve weeks after treatment regrowth ranged from thirty to eighty percent of the original stand. Plots treated with the sodium and amine salts tended to show the quickest as well as the most complete recovery.

Plots sprayed in the fall of 1947, at the fall rosette, pre-frost and after the first fall frost stages showed almost complete wilting of the top growth at all formulations and concentrations.

With the exception of the three fall treatments, seasonal conditions were unfavorable for 2,4-D work. The spring of 1947 was exceptionally cold and dry, resulting in only a very slow growth of both weeds and crop during May and June. July and August were very hot and dry thus again adversely affecting the action of the 2,4-D.

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(6) Assistant in Field Husbandry, Department of Agriculture, Dominion Experimental Station, Scott, Saskatchewan.

Table 2. Effect of 2,4-D on hoary cress at Brandon, Manitoba, D. A. Brown.

Stage and Date of Treatment	Conc. lbs. acid per acre	Estimated percent reduction in stand of top growth at final readings October 6, 1947		
		Ester	Amine Salt	Sodium Salt
Full Emergence (May 16)	2	90	80	92
	1	85	62	58
Pre-bud (May 29)	2	82	92	90
	1	86	79	73
Full Bloom (June 20)	2	97	89	69
	1	100	100	82
Fall Rosette (Sept. 26)	2	85	60	30
	1	65	40	20
Repeat Sprayings (May 16 and 29 and June 20). Spot sprayings (Aug. 26 and Sept. 26).	2	100	100	100
	1	95	94	94

Table 3. Results of tests on hoary cress at Swift Current, Saskatchewan, F. Bisal.

Date treated	Stage	Growth	Chemical	Rate	Temp. F.	Kill leaves, stalks	Kill roots	1947 results
5-7-46	2-3"	Heavy	Weedone	2,3 and 4 lbs./ac. and H_2O	63°	100%	2-3" deep	Regrowth 100%
6-14-46	In flower	Heavy	Weedone	2,3 and 4 lbs./ac.	85°	100%	At least to 6" depth	Regrowth 100%
6-10-47	In flower	Heavy	Weed-no-more	4 lbs./ ac. and oil	59°	100%	2-4"	Sickly regrowth
Resprayed 7-10-47	Young	Sickly	Weed-no-more	4 lbs./ ac. and H_2O	94°	100%	2-4"	None New buds appearing

Table 4. The influence of stage of growth, formulation of 2,4-D and concentration of application (dosage) on hoary cress (Cardaria draba, sp.). H. A. Friesen.

Stage and Date Treated	Type of 2,4-D used	Rate of Application Ounces	Reduction in stand in percent				Regrowth in percent			
			30 days	60 days	90 days	120 days	30 days	60 days	90 days	120 days
		0 Ck.								
	Sodium	8	56	60	78	82	0	26	78	80
	salt	16	61	62	80	88	0	20	76	81
	(Herbate)	24	66	66	90	93	0	18	65	74
		32	72	74	92	92	0	12	70	73
		0 Ck.								
Full	Amine salt	8	68	68	86	87	0	18	75	78
Emergence		16	70	74	90	90	0	18	65	70
(June 5)	(Naugatuck)	24	78	80	90	93	0	12	60	69
		32	78	88	95	97	0	3	40	68
		0 Ck.								
	Ester	8	79	88	90	90	0	6	40	52
	(Weed-no-	16	85	90	90	92	0	3	50	58
	more 40)	24	88	94	94	95	0	0	30	46
		32	86	94	94	94	0	0	30	48
		0 Ck.								
	Sodium	8	80	92	92	92	0	20	59	
	salt	16	86	94	93	95	0	5	58	
	(Herbate)	24	90	93	95	96	0	0	48	
		32	91	96	96	96	0	0	50	
		0 Ck.								
First Bud	Amine salt	8	90	93	93	94	0	0	51	
Stage		16	82	94	94	95	0	0	42	
(June 18)	(Naugatuck)	24	96	94	94	96	0	0	36	
		32	91	95	95	96	0	0	28	
		0 Ck.								
	Ester	8	94	96	97	97	0	0	36	
	(Weed-no-	16	98	98	90	98	0	0	35	
	more 40)	24	100	100	100	100	0	0	22	
		32	99	100	100	100	0	0	18	
		0 Ck.								
	Sodium	8	26	26	38	45	0	32	88	
	salt	16	30	33	34	48	0	30	82	
	(Herbate)	24	32	38	46	52	0	21	80	
		32	40	40	48	56	0	12	82	
		0 Ck.								
Full Bloom	Amine salt	8	8	30	40	44	0	26	86	
Stage		16	39	48	51	55	0	20	85	
(July 9)	(Naugatuck)	24	58	60	63	64	0	11	84	
		32	64	69	72	73	0	7	80	
		0 Ck.								
	Ester	8	25	40	56	64	0	12	85	
	(Weed-no-	16	44	50	60	66	0	0	85	
	more 40)	24	77	78	78	81	0	0	75	
		32	71	75	80	83	0	0	80	

RESULTS OF UNIFORM EXPERIMENTS WITH 2,4-D ON LEAFY SPURGE (Euphorbia Esula)

Leafy Spurge

REGIONAL SUMMARY

H. E. Wood, Winnipeg, Canada

Top growth of leafy spurge can be almost completely destroyed by the application of 2 pounds and upward acid per acre, however, even at heavier concentrations (4 pounds, and occasionally higher), and after repeat applications, the root system a few inches below the surface remains alive and continues to send up new shoots. Repeat treatments, especially when initial treatment is made at time plants are blooming, results often in marked reduction in stand. Sodium salt is less effective in destroying top growth than the esters or amine salts; oil where substituted for water gives no better results.

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ABSTRACTS

The Effect of Concentration of 2,4-D on Leafy Spurge at One Stage of Growth

H. W. Leggett

It would appear that the amine and ester applications which give a quick kill of the top growth reduce the percent stand of leafy spurge materially. There is no chance for the plants to recover during ideal growing conditions as was apparently the case with the sodium salt treated plots.

The leafy spurge roots of both amine and ester treated plots in all concentrations were more seriously damaged than those of the sodium salt plots. While a scattering of buds on the roots of leafy spurge were affected by the sodium salt applications and these only in the 3 and 4 pound concentrations, those buds affected in the amine and ester formulations increased with the concentration and tapered off as the distance from the crown increased. The maximum length of root damage being 4 inches.

The foliage was dense in the original stand, but in the regrowth the foliage was light and the stems weak and spindly in all plots. The seed production on all plots was noticeably reduced when compared with the check plot. This was very evident as the treated plots showed only sterile flowers at freeze-up. The density of the grass increased in the plots which killed quickly regardless of concentration or formulation.

Results on dense stand of leafy spurge on chocolate loam river plateau soil, treated May 29, 1947, in first-bud stage, the plants succulent, using knapsack sprayer (40 lbs. pressure), weather warm and dry.

Treatment (1½ gals. Water)		% Top Growth Killed Av. 3 Rep's	% Re-growth July 9 Av. 3 Rep's	% Re-growth Sept. 3 Av. 3 Rep's	% Plants Set Seed Av. 3 Rep's
Check		0	0	0	88.0
Sodium Salt (Chipman's - 70%)	1 lb.	46.7	45.0	100.0	12.7
	2 lb.	73.3	25.0	96.7	7.0
	3 lb.	83.3	20.0	96.7	6.7
	4 lb.	90.0	18.3	85.0	5.3
Amine Salt (Naugatuck - 30%)	1 lb.	58.3	38.3	88.3	10.3
	2 lb.	86.7	28.3	73.3	5.7
	3 lb.	100.0	26.7	55.0	2.0
	4 lb.	100.0	4.3	53.0	3.3
Butyl Ester (Weed-No-More 40 - 32 %)	1 lb.	95.0	12.7	83.3	5.3
	2 lb.	100.0	6.7	70.0	1.3
	3 lb.	100.0	6.7	48.3	2.0
	4 lb.	100.0	5.0	41.7	1.3

Contributed by: The Dominion Experimental Station,
Lacombe, Alberta, Canada.

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The Use of 2,4-D in the Control of Leafy Spurge

F. Bisal

Treatments with 2,4-D have been unsatisfactory to date in that re-growth of plants has always occurred. Since spraying with 2,4-D was started in 1945, the area has been seeded to crested wheat grass, but the leafy spurge has continued to spread. The soil is a fine sandy loam.

Spraying with the various formulations of 2,4-D has resulted in the killing of the tops and the roots to a depth of 1 to 3 inches, but re-growth has always occurred. This re-growth has taken from 1 to 3 months to appear. One area was sprayed three times in 1947, re-growth appearing after the first and second spraying and the condition of the roots indicate that re-growth will occur in 1948. One spraying in 1947 was made with 2 pounds 2,4-D and 4 gallons diesel fuel per acre, but this was neither more nor less effective than when water was used in the spray.

Results of Tests on Leafy Spurge

Date Treated	Formulation & Concentration	Stage of growth	Temp. F.	Kill Leaves, Stalks	Kill Roots	1947 Results
May 6/46	Ester-Weedone 2, 3, 4 lbs.	Heavy - 14"	55°	100%	Down to 1-2" only	100% re-growth
June 13/46	Amine-Standag 8 lbs.	Heavy - blooming 16"-18"	80°	100%	Down to 2-3" only	100% re-growth
July 4/46	Ester-Weedone 2, 3, 4 lbs.	Blooming 16"-18"	73°	100%	To a few inches	100% re-growth
May 23/47	Sodium Salt-Herbate 2 lbs. in 4 gal. oil	Pre-bloom 12"	59°	100%	1 to 2" deep	Re-growth
July 14/47 (Re-treated)	Ester-Weed-No More 40,2 lbs.	Good re-growth 14"-16"	97°	100%	1 to 2" deep	Re-growth
Aug. 20/47 (Re-treated twice)	Ester-Weed-No-More 40,2 lbs.	Good re-growth 14"-16"	69°	100%	1 to 2" deep	Re growth

Contributed by: Dominion Soil Research Laboratory,
Swift Current, Saskatchewan, Canada.

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Killing Leafy Spurge (Euphorbia Esula) with 2,4-D

H. E. Wood & G. R. Fraser

During 1945-47, approximately 250 plots were devoted to trials with leafy spurge on heavy clay soil near Winnipeg, and on light loam at Winkler. All formulations at concentrations from 1 pound to 10 pounds acid per acre were applied from spring to fall; more than half the plots received one or more re-treatments. No difficulty was experienced in killing top growth (except with light concentrations of sodium salt). In no instance was complete eradication observed; on plots re-treated a measure of "thinning out" was evident. The difficulty in treating this plant with 2,4-D appears to be a matter of translocation into the root system. There is some ground for assuming that leafy spurge is more susceptible to 2,4-D in the flowering to seed-setting stage (midsummer) than at other stages of growth.

Below will be found observations made at three dates at Winkler, sprayed June 6, 1947, and re-treated July 23rd, and again September 5th:

Formulation and Acid Concentration		Estimated re-growth in Percent July 23	Aug. 8	Sept. 5
Sodium Salt - Herbate	1 lb.	60	50	50
	2 lb.	5	15	20
	4 lb.	5	30	35
Ester - Esteron 44	1 lb.	15	20	35
	2 lb.	6	20	30
	4 lb.	12	10	30
Amine Salt - Naugatuck	1 lb.	20	35	35
	2 lb.	2	25	35
	4 lb.	10	20	30
Ester - Weed-No-More 40	4 lb.	5	10	25
Ester - Esteron 44 (Applied July 23)	8 lb.	-	0	10

Contributed by: Weeds Commission, Manitoba Department of Agriculture
Winnipeg, Canada.

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Killing Leafy Spurge with 2,4-D, 1947

D. A. Brown

Seventy-seven quarter square rod plots were used and treatments replicated. Stages at which treatments were applied: (a) full emergence, May 21 (b) pre-bud, June 6 (c) full bloom, August 23 (d) fall rosette, September 23. One range of plots was used for repeat sprayings. Formulations used were ester, amine salt, and sodium salt, at concentrations of 1 and 2 pounds pure acid per acre in 120 U.S. gal. water. Application was made with a knapsack sprayer.

Counts of stand in number of plants were made on permanently staked squares in each plot and percentage stand calculated on the basis of plants per square foot. Results were shown as percentage reduction of original stand plus re-growth. Infestation on the plot area was uniform and dense.

When final readings were made October 4, re-growth was fairly heavy and uniform over all plots except those treated September 23 (fall rosette). On these top growth had been killed off. In the May, June and August applications ester at 2 pounds pure acid per acre showed a reduction in stand of from 40 to 67 percent, amine 54 to 67, and sodium 59 to 68. At 1 lb. per acre ester ranged from 27 to 63 percent reduction in stand, amine 37 to 58 and sodium 36 to 66. On plots sprayed repeatedly at all stages up to August ester at 2 pounds gave an average reduction in stand of 98 percent, amine 73 to 88 and sodium 67 to 76. Diggings in

October showed little root killing in the single treatments at any of the stages, but the repeated sprayings gave root kills estimated at 45 percent.

In 1946, plots were treated at three stages during the season. Single treatments showed less than 10 percent reduction in stand when read in late September 1947, but sprayings repeated three times showed 60 percent reduction in stand.

Stage and Date of Treatment	Concentration lbs. acid per acre	Estimated reduction in stand in percent as at October 4, 1947		
		Ester	Amine Salt	Sodium Salt
Full emergence, May 21	2	40	59	68
	1	46	37	36
Pre-bud, June 6	2	67	67	63
	1	63	48	66
Full bloom, August 23	2	49	54	59
	1	27	58	49
Fall Rosette, September 27	2	100	90	80
	1	100	100	50
Repeat applications all stages and dates	2	98	88	76
	1	98	73	67

Contributed by: Dominion Experimental Farm,
Brandon, Manitoba, Canada.

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Use of 2,4-D for Eradication Leafy Spurge

T. K. Pavlychenko

During 1946, four formulations of 2,4-D were applied as sprays at three concentrations to heavily infested plots of leafy spurge, near Balgonie, Saskatchewan. Plots were replicated three times; were treated at various stages of growth; two series were re-treated once, one series re-treated twice.

The results indicate that one treatment in June was ineffective, as in some plots the weed population a year later was much higher than before treatment. Plots treated in June (pre-bud) and re-treated (one series June 19; another July 19; and August 22) apparently were adversely affected by the June treatment as reduction in stand was only slight. Very marked reduction in stand followed single treatment in July (full bloom) and likewise where July treated plots were re-treated in late August.

Reduction in Stand in Percent*, Leafy Spurge Treated 1946
As Observed June 1, 1947 (Concentrations Expressed p.p.m)

Treatment Date / Stage of Growth	Ester-Weedone			Ester-Dow G-652			Amine-Naugatuck			Sodium Salt Chipman's		
	1000	1500	2000	1000	1500	2000	1000	1500	2000	1000	1500	2000
June 1 (Pre-bud)	0	5	0	8	6	10	0	0	4	0	0	0
July 19 (Full bloom)	66	76	72	69	78	84	60	65	72	33	47	45
August 22 (Fall rosette)	65	72	83	66	77	85	61	61	60	37	37	46
June 1-Jul 19 (Pre-bud, Bloom)	27	40	38	35	36	41	21	20	22	12	19	20
July 5-Aug.22 (Bloom-Fall Ros.)	71	82	84	70	85	90	54	59	64	40	39	49
June 1-Jul. 19 Aug. 22	28	31	38	42	45	53	20	26	31	14	20	26

* Indicated grand total averages. Reduction in individual plots occasionally reaching values of over 90%, as recorded 10 to 11 months after treatments.

Contributed by: Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Saskatchewan, Canada.

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RESULTS OF UNIFORM EXPERIMENTS WITH 2,4-D

ON PERENNIAL SOW THISTLE

REGIONAL SUMMARY

by

Geo. Knowles, Central Experimental Farm, Ottawa.

Abstracts were received from Beaverlodge, Alberta; Scott, Saskatchewan; Winnipeg, Manitoba; and Kapuskasing, Ontario.

In Manitoba the best kill of top growth of perennial sow thistle was obtained when 2,4-D was applied at the advanced flowering to seeding stage of growth. At the three other points where this experiment was conducted, best kills of top growth were obtained when the applications were made during the rapid growth stage.

All experimenters obtained better results from the ester and amine formulations than from the same amounts of sodium salts.

No one treatment gave complete eradication of perennial sow thistle.

One and a half pounds of 2,4-D per acre in the ester form appears to be sufficient to kill the top growth of perennial sow thistle. Heavier rates of amine and sodium salts were required to obtain the same results.

Since three out of four experimenters obtained the best kill of top growth by applying 2,4-D in the rapid growth stage it would appear to be practical to control this weed in oats, wheat, barley and in crops not susceptible to injury from 2,4-D.

Killing Perennial Sow Thistle (Sonchus arvensis) with 2,4-D -

By - H.E. Wood, G.R. Fraser, Manitoba Department of Agriculture, Winnipeg, Manitoba.

During 1945-47, 91 trial plots of this weed were knapsack sprayed with all formulations, 1 to 2 pounds acid per acre, at all stages of growth. This weed was killed back to the ground (ester and amine salts giving better results than sodium salts) with 1½ to 2 pounds acid per acre. Best kills were obtained when the weed was treated in the advanced flower to seeding stage. The following table gives results of plots treated in full flower, August 28th, 1946, with final observations (the average of two separate appraisers) August 27, 1947.

Formulation and Concentration		Estimated Reduction in Stand in Per cent
Sodium Salt - Stantox	.1%	76
	.2%	93
Ester - Weedone	.1%	93
	.2%	82
Ester - Dow's	.1%	96
	.2%	71
Amine Salt-Naugatuck	.1%	90
	.2%	95

While concentrations around 1 pound acid per acre will give a measure of control of sow thistle in a growing crop, the fact that emergence is rather late presents a problem of how best to treat this weed in a grain crop well advanced in stage of growth.

Results of Uniform Experiments with 2,4-D on Perennial Sow Thistle -

By W.R. Wiancko, Dominion Experimental Farm, Kapuskasing, Ontario.

Judging from the results of two years' experiments at Kapuskasing, the best time to apply 2,4-D for perennial sow thistle eradication is when this weed is in first bud. One application is not enough, but when the same treatment is repeated at the same time in the following year the eradication is almost 100 per cent effective.

The ester formulation was the most effective followed by amine and sodium salts in this order. A concentration of 1000 P.P.M. at the rate of 1½ gallons per acre of an ester was just as effective as heavier rates of the same formulation, sodium and amine salts gave a higher percentage kill as the concentrations increased.

Results of 2,4-D treatment on Perennial Sow Thistle at Kapuskasing 1946 and 1947

Chemical Used	Cone P.P.M.	Rate gal. per sq. rd.	Treated Tops Killed after Original Treatment				
			Full Emergence		First Bud		Fall Rosette
			1946	1947	1946	1947	1946
Sodium Salt	500	¾	33.9		58.9		0.0
"	1000	¾	60.4		34.5		0.5
"	1500	¾	43.9		74.1		0.0
"	2000	¾	71.9		91.4		26.0
"	500	1½	58.3		95.5		9.5
"	1000	"	70.3	69.6	97.7	90.3	25.5
"	1500	"	78.1	76.9	97.7	94.1	0.0
"	2000	"	96.7	81.9	97.5	93.5	27.5

Results of 2,4-D treatment on Perennial Sow Thistle at Kapuskasing 1946 and 1947 (cont.)

Chemical Used	Cone P.P.M.	Rate gal. per sq. rd.	Treated Tops Killed after Original Treatment				
			Full Emergence		First Bud		Fall Rosette
			1946	1947	1946	1947	1946
Amine Salt	500	1½	80.5		95.1		0.0
"	1000	"	92.9	47.4	97.8	83.8	0.0
"	1500	"	93.3	76.9	97.3	93.9	0.0
"	2000	"	99.0	85.3	83.8	99.3	23.9
Ester	500	"	89.7		91.1		0.0
"	1000	"	95.6	87.1	82.3	97.7	16.3
"	1500	"	94.6	86.9	93.9	98.3	0.0
"	2000	"	97.1	88.7	78.9	98.9	14.1
"	500	"	97.3		81.6		3.5
"	1000	"	99.1		80.9		18.9
"	1500	"	92.9		63.3		0.0
"	2000	"	97.0		42.3		20.6
Sodium Salt	1500	1	94.7		85.3		0.0
Amine Salt	1500	1	95.5		93.9		28.9
Ester	1500	1	99.7		87.9		0.0
Ester	1500	1	99.7		88.5		0.0

Results of Uniform Experiments with 2,4-D on Perennial Sow Thistle -

By H.A. Friesen, Dominion Experimental Farm, Scott, Sask.

Extensive killing of the top growth of Perennial Sow Thistle was observed when this weed was treated, with sixteen, twenty-four, and thirty-two ounces of 2,4-D per acre, in the bud stage. Eight ounces of 2,4-D per acre resulted in poor kills. The ester type applied at twenty-four and thirty-two ounces per acre, resulted in ninety-eight per cent of the top growth being destroyed. The amine and sodium salt types at these dosages were approximately six and ten per cent less effective. Regrowth, three months after treatment, was only an estimated two per cent of the original stand on plots treated with twenty-four ounces per acre of the ester as compared with ten per cent regrowth on plots treated with an equal dosage of the amine and the sodium salt. Regrowth ranging up to forty per cent was observed on plots treated with only eight ounces of 2,4-D per acre.

With the exception of the ester type at thirty-two ounces per acre, all formulations and dosages gave poor kills, when the treatments were made at the fully emerged stage. All formulations at dosages of eight and sixteen ounces per acre permitted an estimated forty to sixty

per cent of the treated plants to flower and set seed. Regrowth was observed to be very abundant three months after treatment on all plots treated in the fully emerged stage.

The influence of rate and time of application of 2,4-D on Perennial Sow Thistle (Sonchus arvensis) at Scott

Stage of Growth	Date Treated	Type of 2,4-D Used	Dosage	Estimated kill in per cent		Estimated new growth in per cent	
				30 days	90 days	30 days	90 days
Full Emergence	June 7	Sodium Salt	8 oz	10	18	0	68
			16 oz	35	41	0	50
			32 oz	56	62	0	45
		Amine Salt	8 oz	20	28	0	58
			16 oz	42	50	0	40
			32 oz	68	70	0	33
		Ester	8 oz	30	38	0	50
			16 oz	60	62	0	35
			32 oz	89	90	0	20
First Bud	June 28	Sodium salt (Herbate)	8 oz	52	56	0	44
			16 oz	70	81	0	17
			24 oz	86	90	0	10
			32 oz	86	88	0	10
		Amine Salt (naugatuck)	8 oz	38	43	0	40
			16 oz	86	89	0	10
			24 oz	90	90	0	10
			32 oz	90	93	0	8
		Ester (Weed-no-more 40)	8 oz	43	50	0	30
			16 oz	82	90	0	10
			24 oz	90	98	0	2
			32 oz	94	98	0	3

Results of Uniform Experiments with 2,4-D on Perennial Sow Thistle -

By A.C. Carder, Dominion Experimental Farm, Beaverlodge, Alberta.

Compared to the untreated checks, all treatments greatly reduced the thistle population at the end of two seasons.

Some formulations were much more effective than others. The esters were highly effective. The amines were reasonably effective at the stronger concentrations. Sodium salts were the least effective.

A .1 per cent of an ester applied at the rate of 1½ gallons per square rod was almost as effective as higher rates of the same formulation.

Perennial sow thistle was most vulnerable to attack by 2,4-D when in the rapid growth stage.

The value of retreatments was strikingly illustrated and the necessity of continuing applications over more than one year was very apparent.

RESULTS OF APPLYING 2,4-D TO MISCELLANEOUS HERBACEOUS WEEDS

Regional Summary

K. P. Buchholtz

Mis. per. weeds

Poverty weed was eradicated in several instances by using 2,4-D sprays. Most effective results occurred when applications of ester preparations were applied in mid summer to the weed growing in sandy soil. The amine, ammonium and sodium salt preparations were inferior, sometimes decidedly so, to the esters in all cases where comparisons were made. In one case poor kills were obtained on an infestation in heavy clay soil while eradication occurred on plots on sandy soil. Applications of 2 pounds of 2,4-D per acre appear most suitable.

No cases of eradication of Russian knapweed were reported even after three applications of 2,4-D in one case. Top growth was killed consistently by applying 2 pounds per acre of an ester preparation. Less regrowth occurred after pre-bud treatments than after full bloom treatments.

Gumweed was killed by all formulations over a wide range of concentrations at all stages of growth. A 5 per cent amine salt dust gave nearly complete kills but Agroxone was less successful.

Ester preparations killed the top growth of bladder campion when applied at from 2 to 4 pounds per acre. Sodium and amine salts were less effective in killing top growth. Nearly normal regrowth occurred the year after treatment regardless of the preparation, rate or stage of growth treated.

Applications of 1 and 4 pounds per acre of the butyl ester deformed but did not kill wild parsnip plants in the blossom stage. Eight pounds per acre of the ester was effective in destroying them, however.

The top growth of field horsetail in the sterile stage was killed in several instances by applying as little as one-half pound of 2,4-D as the ester or amine salt during the summer months.

Massive applications of the isopropyl and butyl esters of 2,4-D reduced but did not eradicate quack grass. Plots treated 4 times at 2 week intervals with ~~10.7~~ pounds per acre of several esters, showed less than 10 per cent of normal growth after the last treatment. All plots recovered rapidly after treatment was stopped.

ABSTRACTS

The Use of 2,4-D in the Control of Poverty Weed (Iva axillaris Pursh.)

F. Bisal

Treatments carried out on dryland in midsummer of 1946 were very effective, killing the plants and destroying the roots entirely, but treatments earlier in the season reduced the infestation only by 50 to 60 per cent.

Treatments carried out on July 17, 1947, on irrigated land, killed all top growth and roots down to about 6 inches. No regrowth appeared that year. Ultimate results would have to be judged in 1948.

Results of tests on Poverty Weed

Date treated	Stage	Growth	Chemical	Rate Lbs./acre	Top kill	Root kill	1947 results
Dryland May 28/46	2-3"	Heavy	Dow 510 A	2, 3, 4	100%	3-4"	50% reduction
Dryland June 20/46	4-5"	Heavy	Weedone	2, 3, 4	100%	3-4"	60% reduction
Dryland July 20/46	4-6"	Heavy	Weedone, Naugatuck	2, 3, 4	100%	100%	No regrowth
Irrigated land July 17/47	4-6"	Heavy	Weed-no-more 40	0.5, 1, 2	100%	2-3"	No regrowth

Dominion Soil Research Laboratory, Swift Current, Saskatchewan

Killing Poverty Weed (Iva axillaris) with 2,4-D

H. E. Wood, D. S. Stevenson

Four densely infested plots of poverty weed, in the flowering stage (9" high), were knapsack sprayed at a concentration of .2% acid, August 15, 1946. Two months after application the ester preparations were found to have killed the top growth completely and prevented regrowth. The ammonium and amine salt preparations had reduced the stand 18 and 65 per cent respectively. In September of 1947 the plots treated with the ester showed only 4 per cent of the original stand while the plots treated with the salts had nearly complete recovery.

2,4-D Preparation	Estimated Reduction in Stand	
	Oct. 15, 1946	Sept. 25, 1947
Ammonium Salt (Herbate)	18 Pct.	6 Pct.
Ester (Weed-No-More 40)	100	96
Ester (Weedone)	100	96
Amine salt (Dow's)	65	4

Contributed by: The Weeds Commission, Manitoba Department of Agriculture

The Influence of Rate of Application of 2,4-D on Poverty Weed (Iva axillaris)

J. P. Ficht

Plots at Eston, Saskatchewan, were treated July 8th, 1947 with Chipman's (Sodium salt 60 per cent), Naugatuk (Amine 30 per cent) and Weed-No-More 40 (Ester 32 per cent) at rates from one-half to two pounds of pure 2,4-D per acre.

Observations up to September 24th indicated a slow kill of leaves and stems on all plots especially at the lighter rates of application. Land was worked once one month before spraying and tillage operations resumed July 27th.

Although results appeared disappointing on this area at first, the last observation indicated only a small amount of regrowth on any of the plots. The remainder of the field received two extra tillage operations but showed a considerable amount of regrowth.

Results are inconclusive as to determination of desirable rates of application, but indicate the range may be wide enough for experimental work with this weed, although early observations indicated heavier applications should be tried.

Dominion Experimental Station, Swift Current, Saskatchewan, Canada.

Eradication of Poverty Weed (Iva axilaris) by 2,4-D

T. K. Pavlychenko

In July 1945 isolated patches of poverty weed (ave. infestation 227 stems to a sq. yd.) grown on sandy loam and heavy clay loam soils, were treated at the blooming stage with the ethyl ester of 2,4-D (Weedone), at the rate of 1½ lbs. of acid equivalent per acre. The weed reacted very erratically. The infestation on sandy loam was permanently eradicated with one application. That on the heavy clay loam was slightly reduced but almost fully recovered in 1946 and 1947.

In 1947 tests were repeated at the same stage on the heavy clay loam but four different chemicals were used, butyl ester, amine salt, sodium salt and free acid. The butyl ester killed the top growth but some regrowth occurred late in the fall. The other preparations were less effective failing to kill all top growth and allowing more regrowth.

Chemical	Lbs./ acre	Soil	Percent reduction in stand			
			One mo. after treat.	Fall of 1945	Fall of 1946	Fall of 1947
1945 treatments						
Weedone	1½	Sandy loam	100	100	100	100
"	"	Hv. clay loam	100	83	24	11
1947 treatments						
Butyl ester	1½	Hv. clay loam	100	—	—	88
Amine salt	"	"	78	—	—	45
Sodium salt	"	"	21	—	—	10
Free acid	"	"	18	—	—	7

Laboratory of Plant Ecology, University of Saskatchewan

Effect of 2,4-D on Russian Knapweed (Centaurea repens)

T. K. Pavlychenko

In July 1945 a portion of a solid infestation (102 stems to a sq. yd.) on a heavy clay loam was isolated by deep trenches filled with soil sterilized by sodium chlorate. The isolated area was treated with ethyl ester (Weedone) 1500 ppm (1½ lbs. acid eq./ac.) at the bloom stage. Results: In 45 days the top growth was 100 per cent killed. Counts taken late in the fall of 1945, 1946 and on June 13, 1947 showed some regrowth but not more than 1 or 2 per cent of the original stand. On June 13, 1947 the initial treatment was repeated and the results of both treatments by the late fall of 1947 were as follows:

Pounds/acre	Percent Regrowth			
	45 days after treatment	Fall of 1945	Fall of 1946	Fall of 1947
Initial treatment, July 6, 1945				
1½	0	.6	1.9	—
Retreatment June 13, 1947				
1½	0	—	—	.2

Laboratory of Plant Ecology, University of Saskatchewan

Killing Russian Knapweed (Centaurea repens) with 2,4-D

D. A. Brown

A small patch was secured for treatment near Hartney, Manitoba. Plots one-quarter square rod in size were used and butyl and isopropyl ester were applied at 2 pounds acid per acre. Treatments in duplicate were made at the pre-bud stage (June 6, 1947) and full bloom (June 25). Additional plots were used for repeated sprayings on the same dates. Applications were made with a knapsack sprayer using 120 U. S. gallons water per acre.

Final readings were made on September 24. At the pre-bud stage butyl ester had reduced the stand above ground by 95 per cent and isopropyl ester 97, and at full bloom 80 and 85 per cent respectively. On the repeat sprayings both treatments had reduced top growth 97 per cent. Diggings showed that about 50 per cent of roots were killed in the pre-bud single spraying treatment, 20 per cent in the full bloom treatment and 75 per cent in the plots sprayed twice. The pre-bud sprayings done in bright, dry weather at a temperature of 72°F. were much more effective than the full bloom sprayings done in moist but bright weather at a temperature of 85°F.

Contributed by Dominion Experimental Farm, Brandon, Manitoba.

The Use of Hormone-Like Herbicides in the Control of Russian Knapweed (Centaurea picris Pall.)

F. Bisal

Complete kill of tops and roots to a depth of 6 inches was obtained soon after spraying with Weedone and Standag in June, 1945. By October of that year, however, a regrowth of about 50 per cent of the original number appeared. This regrowth was sprayed with "Weed-no-more 40" in June, 1947, killing 95 per cent of the plants down to 2 or 3 inches. A second fairly healthy regrowth appeared within a month. The area was sprayed again with the same chemical and rate of application on July 14, 1947. There is no indication that the weed has been killed with this final application. The new regrowth appears to have a higher resistance to the chemical than the old.

Results of tests on Russian Knapweed

Date treated	Stage	Growth	Chemical	Rate Lbs./acre	Top kill	Root kill	1947 results
June 13/46	10", in flower	Heavy	Weedone Standag	2,3, 4	100%	To depth of 6"	60% regrowth
Resprayed June 11/47	Budding	Medium	Weed-no-more 40 & oil	2 in 4 gal. oil	95%	To depth of 2-3"	Regrowth
Resprayed July 14/47	Some in flower	Light	Weed-no-more 40 & H_2O	2	95%	To depth of 2-3"	Buds formed by autumn

Dominion Soil Research Laboratory, Swift Current, Saskatchewan.

Killing Gumweed (Grindelia squarrosa) with 2,4-D

H. E. Wood, G. R. Fraser

During 1945-47, 30 plots were devoted to trials on gumweed - a bad pasture weed. All formulations at a wide range of concentration were used on all stages of growth. Results showed perfect or almost perfect kills in all cases. In 1946, two plots were dusted - one with a 5% amine salt dust; the other with Agroxone (a product of Imperial Chemical Industries). The amine dust gave an almost perfect kill; the Agroxone, 75% kill.

The Weeds Commission, Manitoba Department of Agriculture

Killing Bladder Campion (Silene latifolia) with 2,4-D

D. A. Brown

A heavy infestation was treated in 1946 with ester, amine and sodium salt at concentrations of 4 lbs. and 2 lbs. acid per acre. Applications were made at full bloom and post bloom stages (June 26 and July 5) by use of a knapsack sprayer, at the rate of 120 U. S. gal. of water per acre.

Esters cut back all top growth to the ground within one week. Amines reduced the stand 75 per cent and sodium salts 60 per cent. Regrowth came thickly in September and readings June 15, 1947 indicated almost 100 per cent regrowth in all formulations, concentrations and stages of treatment.

Contributed by Dominion Experimental Farm, Brandon, Manitoba.

Effect of 2,4-D on Wild Parsnips

Homer B. Neville, C. J. Willard

Wild parsnips at the blossom stage were sprayed with the butyl ester of 2,4-D. At the rate of 4 pounds of 2,4-D acid per acre the plants were badly deformed and seeding prevented. At 8 pounds per acre the plants were killed. A pasture containing a great quantity of wild parsnip was sprayed with concentrated butyl ester spray at the rate of 1 pound per acre of 2,4-D acid. The parnsips were 30 inches tall and in bud. The plants were deformed but not killed. Within a week after treatment, cattle had grazed most of the sprayed plants to 6 to 12 inch stubs but had not touched the unsprayed parsnips.

Ohio Agricultural Experiment Station in cooperation with the Sherwin-Williams Company.

Killing Field Horsetail (Equisetum arvense) with 2,4-D

H. E. Wood, G. R. Fraser

Although no plots were devoted solely to this weed in the "fertile stem" stage, it was met with frequently in other plots. The plant "killed" to the ground very readily with the several formulations at various concentrations, although the effect upon the root is not known.

On August 29, 1947, two 3-acre plots densely infested with horsetail, in the "sterile stage" two to six inches in height, on heavy clay loam soil under summerfallow, were machine sprayed, 20 gallons water per acre, one with Esteron 44 at 1 pound, the other Stantox amine salt at 1/2 pound acid per acre. When checked a month later growth on both plots was killed back to ground level.

Contributed by: The Weeds Commission, Manitoba Department of Agriculture.

Using 2,4-D on Quack Grass

C. J. Willard and Homer B. Neville

Quack grass has repeatedly withstood single applications of 20 pounds per acre (10,000 ppm) of 2,4-D acid in either the sodium salt or ester form. The bad results of repeated applications of 2,4-D to lawns suggested that repeated applications might eradicate quack. An experiment was laid out, starting April 23 in vigorous quack grass, to treat quack grass with the iso-propyl and butyl esters of 2,4-D at the rate of 2.7, 5.3 and 10.7 pounds per acre of acid two, three and four times, at intervals of 1, 2, and 3 weeks. The 2-week interval caused more damage than the one-week or 3-week intervals. The plots treated 4 times at 10.7 pounds of acid per acre at a 2-week interval were reduced to less than 10% of normal growth on June 18th. However, by August the plots were recovering strongly, so there was no eradication, even by these expensive applications. On the acid basis used, the butyl ester was slightly but perceptibly more effective than the iso-propyl ester.

Ohio Agricultural Experiment Station in cooperation with Dow Chemical Company and Sherwin-Williams Company.

RESULTS OF UNIFORM EXPERIMENTS ON RATE OF APPLYING 2,4-D AND OTHER SELECTIVE HERBICIDES ON ANNUAL WEEDS IN CEREALS, GRASSES OR FLAX

Regional Summary

L. M. Stahler

Reported data of experiments using 2,4-D and dinitro herbicides to control annual or biennual weeds in cereal grains, flax and grasses definitely establish 2,4-D as an efficient new aid to the grain farmer in the north central area. Experimental evidence, results of field use, and new developments in airplane and low volume spray application of 2,4-D predict a greatly expanded use of this selective herbicide in 1948 and succeeding years and a decline in the use of the dinitro compounds.

Despite expanded research and field use of 2,4-D, several important considerations in regard to its use must be more definitely established before we can make clear cut recommendations with assurance. The relative merits and hazards of the severe common forms of 2,4-D; the ester, amines and sodium salts, cannot be clearly defin from abstracts of data available. Likewise, optimum levels of application sufficient to control weeds with a minimum of injury to the growing crop cannot be derived from data on hand.

Cereals Flax

The variability in data of abstracts is largely due to lack of uniformity in materials and methods used in the reported experiments and the wide range of field conditions under which they were applied. It is well known that the several commercial forms of sodium salt of 2,4-D vary greatly in efficiency--the older mixed salts being less efficient than the newer soluble manohydrate forms. Reports indicating a poor kill of annual weeds by the sodium salts were almost invariably from experimentors using the old, insoluble forms.

(1) Agronomist Bureau of Plant Industry Soils and Agricultural Engineering U.S.D.A. Lamberton, Minnesota

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The tolerance of crops to the sodium salts, likewise, is not truly reflected by data derived from treatment with an insoluble salt.

The broad leaved annual weeds commonly infesting spring planted cereals, flax and grasses are mostly susceptible to 2,4-D at rates of application below the level detrimental to the crops. Mustards, Frenchweed, Sunflower, Ragweeds, Marshelder, Pigweeds, Lambsquarters, Cocklebur and similar species, when treated in late seedling stage have been consistently controlled by reported applications of from one-fourth to one-half pounds 2,4-D acid per acre in the form of esters, amines and soluble sodium salts. When the older partly soluble forms of sodium salt were used, one-half to three-fourths pounds 2,4-D acid per acre were required. In cereal grains-oats, wheat, and barley, these rates of application at the full tiller stage of growth have as an average of all data submitted, increased yields of harvested grain, had no detrimental effect on germination of the grain seed.

Certain, more tolerant weeds commonly infesting spring grains and flax, such as Wild buckwheat, Russian thistle, Wild lettuce; are indicated as requiring at least one-half pound 2,4-D acid per acre for elimination under most favorable conditions; ie., while in the rapidly growing post-seedling stage. Applications of one-fourth to one-half pound 2,4-D acid per acre have consistently controlled these weeds--stunting growth and preventing seed formation. Reported data indicating poor control of these species, as well as the more susceptible species previously discussed, were invariably from applications made when the weeds were in a late stage of development; ie., bud to full bloom. At the later stages of development weeds have already done most of their potential damage to their companion crops; are proven to be more tolerant of 2,4-D, and grain is more sensitive to the herbicide. For these reasons data indicating late applications has not been given equal weight with data from experiments applied at more practical stages of development, in determining regional summaries.

Flax is indicated to be less tolerant of 2,4-D than the cereal crops, but control of the susceptible broad leaved annuals that are associated with its culture are successfully reported by several contributors. Annual weeds are killed or controlled by one-fourth to one-half pounds 2,4-D acid per acre, applied when flax is two to four inches high without marked injury to the crop. Higher rates of applications

are indicated to be hazardous at all stages of growth.

Few reports on grasses indicate that 2,4-D can be safely used to control all susceptible species of annual and winter annual weeds associated with these crops without marked reduction in seed or forage yield. Rates of application of one-fourth to one and one-half pounds 2,4-D acid per acre are reported as used successfully. Buffalograss, is an exception to the general rule, being sensitive to high rates of application of 2,4-D. Application on all grasses, when weeds are small and before seed heads appear on the grass are reported as optimum in weed kill with minimum damage to the grass crop.

From the abstract data, it is evident that the ester formulations tested have quite consistently given better control of weeds under all conditions of application, and likewise more severe damage to oats, wheat, barley and flax, than other formulations of 2,4-D at comparable rates of application. Data are not consistent enough to justify specific recommendations for rates of application for each specific formulation of 2,4-D. On the basis of the data submitted it appears logical to recommend that the ester formulations be used at the lower level under best conditions of applications and at the maximum level where conditions are not optimum.

A summary of abstracts of twelve experimentors representing twenty experiments indicates general agreement on the following suggested practices:

A. Use of 2,4-D in flax.
   (1) For control of Mustard (Brassica spp.), Frenchweed (Thlaspi arvensis), Sunflower (Helianthus annus), Cocklebur (Xanthium spp.), Wild buckwheat (Polygonum convolvulus), Ragweed (Ambrosia artemesifolia), Marshelder ((Iva xanthifolia) and similar susceptible species:
      a) Apply not to exceed one-fourth pound (acid equivalent) 2,4-D per acre.
      b) Make applications when flax is two to four inches high and weeds are in the four leaf, or rosette stage.
   (2) For control of Bindweed (Convolvulus arvensis), Canada thistle (Cirsium arvense), Sow thistle (Sonchus arvensis), Smartweed (Polygonum spp.), Wild lettuce (Lactuca spp.), Artichoke (Helianthus tuberosa) and other similar species:
      a) Use from one-half to three-fourths pounds of 2,4-D acid per acre as required to control the weed species involved.
      b) Apply when flax is six inches to first bud or when weeds are in rapid growth but pre-bloom stage.

B. Use of 2,4-D in barley, oats or wheat.
   (1) For control of weeds, such as Mustards (Brassica spp.), Frenchweed (Thlaspi arvensis), Marshelder (Iva xanthifolia), Ragweed (Ambrosia spp.) Wild buckwheat (Polygnum convolvulus), Hedgebindweed (Convolvulus sepium) and similar susceptible species:
      a) One-fourth pound (acid equivalent) of 2,4-D per acre,
      b) Apply at full tiller stage.

C. Use of 2,4-D in grasses.
   (1) Use only enough 2,4-D to control the weeds infesting the grasses. One-fourth to one-half pound 2,4-D acid per acre for susceptible annuals and biennuals; one-half to one and one-half pounds 2,4-D acid per acre for more resistant species.

D. Use of dinitro herbicides in growing crops.
   (1) For the control of annual weeds in crops sensitive to 2,4-D, such as canning peas, field peas, alfalfa etc., the ammonium salts of the dinitros are recommended as per manufacturers schedule.

Chemical Control of Weeds in Flax

A. L. Bakke,
Iowa Agricultural Experiment Station

Previously Sinox and Dow Selective in dilute concentrations have been recommended as herbicides for the control of annuals in flax. The Sherwin-Williams Co., of Cleveland, Ohio, manufacturers of Weed-No-More cooperated with the Iowa Agricultural Experiment Station in ascertaining whether a dilute solution of Weed-No-More could not be used. Concentrations of Weed-No-More 40 ranging from 1/8 of a pint to one pint per acre in 100 gallons of water were used to spray flax at Kanawha, Iowa where Pennsylvania smart weed infestation was heavy. The results were as follows: 1/8 pint 22.86 bushels per acre, 1/4 pint-18.45 bushels, 1/2 pint-20.68 bushels, and one pint 17.25 bushels. Sinox W. in the recommended concentration yielded 14.76 bushels per acre, Dow Selective 18.76 bushels. Santobrite (sodium pentachlorophenate) 1/2 percent yielded 18.86 bushels. From the data gotten at Kanawha, Iowa it is evident that a dilute solution of Weed-No-More (butyl ester) can be used to control weeds like the Pennsylvania smart weed. At Crystal Lake, Iowa Dow Selective yielded 22.19 bushels per acre, Santobrite (1/2 percent) 24.22 bushels and the control 1.2 bushels.

Yields per acre from chemical treatment of flax
8-10 inches high-June 14, 1947 at rate of 100 gals. per acre
Kanawha, Iowa

Chemical	Infestation per sq. ft. smartweed	No. of plants in rod row-time of harvest flax	smartweed	Weight per bushel	Yield per acre bushels
Weed-No-More-1/8 pt.	2300	182	27	52.2	22.86
Weed-No-More-1/4 pt.	ditto	186	33	52.2	18.45
Weed-No-More-1/2 pt.	"	154	65	51.6	20.68
Weed-No-More-1 pt.	"	150	150	----	17.25
Weed-No-More dust 10%	"	188	42	52.4	22.40
Sinox W	"	200	350	-----	14.76
Sinox dust	"	146	31	48.2	19.18
Dow Selective	"	122	39	49.6	18.76
Dow Selective	"	194	53	----	15.80
Santobrite 1/2%	"	185	28	----	18.86
Santobrite 1/4%	"	259	219	----	17.30
Control-No treatment	ditto	217	114	49.2	17.15
Crystal Lake, Iowa					
Dow Selective	Heavy	486	34	52.8	22.19
Santobrite 1/2%	ditto	549	5	53.6	24.22
Control	ditto	481	70 (40")	----	1.2

Spraying Oats with 2,4-D

A. D. Bakke,
Iowa Agricultural Experiment Station

Oats (Clinton) 8-10 inches tall heavily infested with Pennsylvania smart weed and other annuals was sprayed with various chemicals. The data have been recorded in the following table:

Yields per acre from chemical treatment of Clinton Oats 8-10 inches high June 19, 1947--Kanawha, Iowa
Principal weed-Pennsylvania smartweed--three inches, 36 per sq. yd.-100 gals. per acre.

Chemical used	Concentration 100 gals.	Weight per bushel	Yield per acre bushels
Weed-No-More 40	1/8 pint	36.5	74.02
Weed-No-More 40	1/4 pint	38.0	66.84
Weed-No-More 40	1/2 pint	37.6	58.11
Weed-No-More 40	1 pint	37.8	55.29
Weed-No-More 40	10 gals. per acre	37.2	61.29
No treatment	Control	37.4	67.53
Sinox W	4 pints	38.2	57.29
Santobrite*	4 lbs.	37.7	69.93
Santobrite	2 lbs.	36.0	68.93
Tufor 40	1 quart	36.6	93.94
Dow-Sodium salt	20 oz.	36.8	95.03

*Sodium pentachlorophenate.

Solutions as dilute as 1/8 pint of Weed-No-More controlled the annual weeds in oats. Oats sprayed with the amine formulation (Tufor 40-one quart) gave higher yields than the control; the same was true for the sodium salt (Dow).

Killing Annual and Winter Annual Weeds in grain crops with 2,4-D. 1947

D. A. Brown Dominion Experimental Farm, Brandon, Manitoba

Areas of wheat, oats, barley and flax known to be infested with many common annual weeds were laid out into 130 half-square-rod plots to provide replicates of each concentration and formulation of ester, amine salt, sodium salt and a 2,4-D dust. Treatments were applied with a knapsack sprayer at concentrations of 4, 8, and 16 ounces of acid in 120 U.S. gall. of water per acre. Grain was six inches high and weeds in the four leaf to budding stage at time of spraying and dusting.

Wild mustard (Brassica arvensis) was 98 per cent killed by all formulations and concentrations of spray but dust gave poor results. Other weeds present and kills in per cent by sprays were Lambs-quarters (Chenopodium alba) 75, Frenchweed (Thlaspi arvense) 90, Red root (Amaranthus retroflexus) 80. Dust made poor kills in every case. Weeds not killed by any treatment were Wild buckwheat (polygonum convolvulus), sticky cockle (Silene noctiflora).

Wheat yields were significantly higher on sprayed and dusted plots, barley slightly higher, and oats slightly lower than untreated plots. All treatments significantly reduced flax yields. Ester at 1 lb. and 8 oz. was particularly severe on flax plants, but all formulations at 4 oz. showed little injurious effect.

Yields of Grain in knapsack sprayed plots, Phillips Farm, Forrest, Man.

Treatment	Yield expressed in per cent check plots (100)			
	Wheat %	Oats	Barley %	Flax %
Sodium Salt 4 oz.	111	85	77	84
8 oz.	109	95	116	53
16 oz.	141	97	113	86
Average 3 concentrations	120	93	102	74
Ester 4 oz.	119	94	97	68
8 oz.	93	99	106	63
16 oz.	82	85	62	92
Average 3 concentrations	98	93	88	74
Amine Salt 4 oz.	132	99	99	78
8 oz. (continued)	105	105	80	73

		Wheat %	Oats %	Barley	Flax %
	16 oz.	109	102	84	115
Average 3 concentrations		115	102	88	89
Dust	4 oz.	102	88	102	88
	8 oz.	171	97	82	61
	16 oz.	110	89	124	101
Average 3 concentrations		128	91	103	83

Killing Annual and Winter Annual Weeds in Flax Crop with 2,4-D. 1947

D. A. Brown.

A low pressure 16-foot boom sprayer was used to apply ester, amine salt and sodium salt on 1/8 acre replicated plots of flax in a field that was very heavily infested with wild mustard (Brassica arvense) and Green foxtail (Setaria viridus). All formulations were applied at 8 oz. acid per acre in approximately 85 U.S. gall. of water. Almost complete kills were obtained from all three formulations of common mustard, but green foxtail and a light infestation of sticky cockle (Silene noctiflora) remained uninjured. Assuming the yield from check plots as 100 per cent, ester treated plots gave 163 per cent, Amine salt 164 and sodium salt 130. Ester gave a thicker, but retarded growth of flax and distinct malformations of bolls. Amine and sodium salts also held back maturity, but injury was slight. The significant increase in yield from all formulations was possibly in large part due to the timely killing of mustard that ran as high as 165 plants per sq. ft. As the season advanced green foxtail which remained uninjured was afforded a better chance to grow on treated plots and by harvest time it was obviously more prominent in the treated than the check plots.

Weed Count and Grain Yields on Machine sprayed plots C. H. Meadows Farm, Forrest, Man.,--1947. All plots treated with 8 ounces acid per acre.

	Weed Count Before and After Treatment per sq. ft.						Yield per ac. in %
	Common Mustard		Sticky Cockle		Green Foxtail		Checks at 100 %
Formulation	Before	After	Before	After	Before	After	
Sodium salt	165	2	6	7	106	114	130
Amine salt	137	0	4	1	120	132	164
Ester	142	0	8	6	108	120	163
Check untreated	146	132	10	12	114	136	100
Separate Experiment:							
Sinox	149	0	9	5	97	110	147
Check (untreated)	137	140	3	6	104	134	100

Contributed by-Dominion Experimental Farm

Response of Koto flax to applications of 2,4-D.

Dunham, R. S.

Koto flax was sown in row plots with rows 12 inches apart, so that weeds could be controlled by hoeing. Treatments consisted of spraying with the sodium salt, amine salt, and ester of 2,4-D at 4 oz, 12 oz, and 24 oz. of acid equivalent per acre and at plant stages of 2 inches, pre-bud, late bud, and full bloom. Check plots were sprayed with equal amounts of water. All rates and stages were included in a block for each chemical to reduce danger of drifting. The individual plots of rates included three rows; the center one received the treatment and was harvested for yield the two outside rows were borders for protection against drift. A separate sprayer was used for each formulation. The plots were replicated 4 times and carried on at St. Paul and Waseca.

Sprayed at the 2-inch stage and at 4 oz., there was no significant reduction in yield for any formulation. At 12 oz. the ester appeared injurious although reductions in seed yields were not significant at the 5 % point. All formulations appeared injurious at 24 oz. At pre-bud the ester was injurious at 4 oz. and the amine at 12 oz.

(Continued)

Germination tests showed no injury to the viability of the seed harvested from plots treated at these stages. From the trial by Tandon and Dunham it is known that Koto is one of the more tolerant varieties.

Applications were made at late stages primarily to determine any effect on the genetic constitution of the crop. This information will be available next season. Oil percentages and iodine numbers will be available later this year.

University of Minn., St. Paul, Division of Agronomy and Plant Genetics in cooperation with Sherwin-Williams Co.

DEPARTMENT OF AGRICULTURE ---------- EXPERIMENTAL FARMS SERVICE

Rate of Applying 2,4-D on Annuals and Winter Annual Weeds in Cereals and Flax.

Tumbling Mustard, Sysymbrium altissimum
Stinkweed, Thlapsi arvense
Flaxweed, Sophia multifida
Russian Thistle, Salsola pestifer
Lamb's Quarter, Chenopodium album..... By J.P. Ficht

Chemicals used were Chipman's (Sodium salt 60 per cent), Naugatuk (Amine 30 per cent), Weed-No-More 40 (Ester 32 per cent). All were used at one-quarter and one-half pound pure 2,4-D per acre.

The one-quarter pound per acre rate of application resulted in satisfactory kills of tumbling mustard, stinkweed and Lamb's quarter in all cases where the Amine or Ester were used. The one-quarter pound rate with the Sodium salt was inclined to be slow and gave incomplete kills.

Flaxweed and Russian thistle were distinctly more resistant than the others, but in early stages of growth (about 3 inches high) they were satisfactorily destroyed by the Amine and Ester at one-half pound per acre. Results with the Sodium salt at one-half pound per acre were not entirely satisfactory but inconclusive due to uneven distribution by the turbine mist sprayer which was used.

JPF/aw

DOMINION EXPERIMENTAL STATION,
Swift Current, Sask.,
Canada.

Experiment 2 Rate of applying 2,4-D and other Selective Herbicides on Annual and Winter Annual Weeds in Cereals and Flax.

By-- H. A. Friesen--Assistant in Field Husbandry.

ABSTRACT

Plots of Rescue wheat, Ajax oats, Prospect barley, Prolific spring rye and Royal flax were used in this test. Eleven treatments, involving the three types of 2,4-D at each of the three concentrations outlined in this experiment were used, as well as a five percent sodium salt dust at eight pounds per acre and Sinox at one gallon per acre.

Because of the abnormally cold dry spring the germination of the weed seeds was so much delayed that practically free of seeds. Observations and weed counts showed no significant differences between the treated and untreated plots. Observable damage to the crops as a result of the treatments was confined to oats, where the eight and sixteen ounce per acre rate of the butyl ester resulted in a lodged appearance of the crop. Some plants were also found to have thick short internodes and club-like panicles. The treatments did not significantly affect the yields of wheat, oats, barley or spring rye.

The results were quite striking with flax. Because of delayed seeding, stinkweed, Lambs Quarter, Wild Buckwheat and especially Russian Thistle were abundant. The stinkweed and Lambs Quarters were controlled by all formulations and rates. Russian thistle was controlled quite effectively by the eight and sixteen ounce rates of the ester and the sixteen ounce rate of the amine. Yields on these plots were approximately four times as great as the yields on the other treatments and the checks. The eight and sixteen ounce rates delayed maturity in flax from 8 to 10 days as compared with the check. Wild Buckwheat was not effectively controlled by any of the treatments.

Contributor: DOMINION EXPERIMENTAL STATION

HERBICIDAL POSSIBILITIES OF 2,4-DDICHLOROPHENOXYACETIC ACID IN FLAX

(Uniform Experiments) by T. K. Pavlychenke,
Laboratory of Plant Ecology, University of Saskatchewan,
Saskatoon, Sask.

Extensive tests with various 2,4-D dusts on flax were made at Saskatoon in 1947. The soil was a heavy clay loam. The spring was dry, cold and late and the summer dry and cool.

Principal weeds were: stinkweed (Thlaspi arvense), Russian thistle (Salsola Koli), wild mustard (Sinopis arvensis), tumble weed (Amaranthus graecizans), Lamb's quarters (Chenopodium album), and Red root pigweed (Amaranthus retzolflexus).

Plots were 20 by 140 ft. in size. The following chemicals were used as dusts at the rate of 6 ounces of acid equivalent per acre dispersed by the John Deer cotton duster: 5 percent butyl, methyl and Isopropyl esters; 5 percent triethanolamine; 5 and 3 percent sodium salt; 5 percent free acid and 5 percent Killo-weed (free acid). At the time of treatment the weeds were rank and in the bud or flowering stage. Their density was from 700 to 1100 plants to a sq. yd. The flax was small and very patchy, but healthy. It offered an excellant material for studying its resistance to the chemicals but was insufficient for yield determinations.

Results: The crop successfully resisted all the chemicals, particularly sodium salts, and produced good bolls with apparently normal seed. Isopropyl ester alone caused slight curling of the crop which soon recovered. The effect of various chemicals on different weeds is given in the following records, which represent averages of eight, one sq. yd. sample counts taken from each treatment:

Weeds	esters - 5 percent			Amine Salt 5 percent	Sodium Salt 5 per-cent	3 per-cent	Free acid 5 %	Killo-weed 5 %
	Butyl	Methyl	Isopropyl					
				PERCENT KILL				
Wild Mustard	100	100	100	91	69	28	93	100
Stinkweed	98	96	100	82	49	13	80	94
Lamb's quarters	79	77	89	70	19	0	83	91
Russian thistle (blooming stage)	35	36	41	10	0	0	38	40
Red root pigweed	21	23	26	18	5	0	18	14
Tumble weed	12	10	21	8	0	0	9	10
Flax	0	0	0	0	0	0	0	0
			slight curling					

EFFECT OF 2,4-DICHLOROPHENOXYACETIC ACID UPON ANNUAL WEEDS AND GRAIN YIELDS:

(Uniform experiments on Rates) by T. K. Pavlychenko, Laboratory of Plant Exology, University of Saskatchewan, Saskatoon, Sask.

The ester, amine and sodium salt groups of 2,4-D were tested in the dry prairie regions of the Saskatchewan to control annual weeds in grain crops. Heavy clay, heavy clay loam, silt loam and sandy loam soils were included in widely separated districts. The chemicals were used at the rates of 4, 8, 12 and 16 ounces of the acid equivalent in 10 gallons of water per acre, applied from the Fargo boom sprayer at temperatures of 60 to 78 degrees F. with weeds in a pre-bud stage.

The principal weeds were: at Regina, wild mustard (Sinapis arvensis); at Saskatoon, stinkweed (Thlaspi arvense), wild mustard and Russian thistle (Salsola Kali); at Cavell, stinkweed, Russian thistle and hare's ear mustard (Coringia orientalis); at Young, wild mustard, stinkweed and cow cokle (Saponaria vaccaria).

Plots were 3300 sq. ft. and the data mentioned herein are averages of 8 randomized, one sq. yd. samples.

Results: The weeds susceptable to 2,4-D were controlled 90 to 100 per cent by esters; 73 to 100 by amine salts and 63 to 88 by sodium salts. The kinds of chemicals and the stages of weed growth were more important than the rates used. Grain yields were significantly increased in most plots. Commercial grades were not effected. Occasional deformations occured on heads and leaves, particularly of young tillers (lax or club spikes and 2-3 bladed leaves). These occured more frequently in crops treated early (3-4 inches high) and seldom in those more advanced (previous to heading). All annual weeds developed everincreasing resistance from the flowering to maturity. The data from this work are included in Table I.

Table I. Effect of 2,4-D on Weeds and Grain Yields

Treatment	WHEAT				BARLEY			
	Regina		Saskatoon		Cavell		Young	
	weeds percent killed	grain yield bus.-ac	weeds percent killed	grain yield bus-ac.	weeds percent killed	grain yield bus-ac.	weeds percent killed	grain yield bus-ac.
Butyl ester	0	33.2	0	22.2	0	3.5	0	11.0
4 ounces-ac.	92	38.6	100	24.5	99	4.4	90	12.2
8 ounces-ac.	100	36.4	100	27.1	99	7.6	94	10.1
12 ounces-ac.	100	41.4	98	24.8	100	8.9	95	11.3
16 ounces-ac.	100	36.6	100	23.7	100	9.3	98	20.1
Amine salt check	0	31.6	0	18.9	0	6.3	0	11.8
4 ounces-ac.	89	39.8	78	23.1	83	6.8	73	10.2
8 " "	94	38.7	86	23.9	89	6.4	91	16.2
12 " "	100	40.6	89	25.2	92	6.8	87	15.6
16 " "	100	35.2	84	24.1	84	9.2	88	17.8
Sodium salt check	0	34.8	0	15.8	0	4.5	0	7.6
4 ounces-ac.	78	38.8	68	15.3	77	6.4	63	11.5
8 " "	86	39.5	71	21.2	73	6.4	71	13.9
12 " "	84	39.7	70	20.1	70	7.7	87	14.9
16 " "	87	39.8	73	22.2	74	7.7	88	20.3

USE OF SINOX W FOR CONTROLLING ANNUAL WEEDS IN GRAIN CROPS (Uniform experiments with dinitro compounds) by T. K. Pavlychenko, Laboratory of Plant Ecology, University of Saskatchewan, Saskatoon, Sask.

In 1947 experiments with Sinox W were carried out throughout the dry prairie region, the prairie-forest transition zone and the park belt of Saskatchewan. All major soil types from heavy clay to sandy loam were included. Plots were from 3300 sq. ft. to 2.4 acres. The treatments were made with the Fargo boom sprayer using 80 gallons of water per acre. The principal weeds in the crops treated were wild mustard (Sinapsis arvensis), stinkweed (Thlaspi arvense), Russian thistle (Salsola kali), Lamb's-quarters (Chenopodium album), wild buckwheat (Polygonum convolvulus) and Hare's ear mustard (Coringia orientalis).

Results: Young seedlings (4 to 12 leaf stage) of the wild mustard, stinkweed, and Russian thistle were effectively controlled. Hare's ear mustard and Lamb's quarters of the same age were seriously injured with a tendency to recover. Wild buckwheat generally escaped injury from lighter applications (4 pts.) but was set back by stronger doses (6-8 pts.).

Unlike 2,4-D Sinox at the above rates had no other effect on crops than slight leaf burning if applied at temperatures above 80°F. This generally had a stimulating rather than harmful effect on yield. The chemical was most effective where the soil was heavy, the stand of crop uniform, the ground moisture before the treatment plentiful and the growing conditions after the treatment favorable. Otherwise, the

treated plots were frequently reinfested with weeds and benefits from the initial destruction of weeds considerably lost. The data from these experiments are given in Table I.

Table I. Use of Sinox W for controlling annual weeds in grain crops.

Treatment	WHEAT						BARLEY	
	Regina		Saskatoon		Cavel		Young	
	Weeds percent killed	Grain yield bu-ac.	Weeds percent killed	Grain yield bu-ac.	Weeds percent killed	Grain yield bu-ac.	Weeds percent killed	Grain yield bu-ac.
Series A.								
Check	0	22.4	0	12.4	0	6.3	0	10.5
4 pts.-ac.	98	37.8	65	15.7	82	8.5	47	11.7
6 pts.-ac.	100	32.9	79	19.8	78	7.8	53	11.2
8 pts.-ac.	100	31.1	95	12.9	97	7.4	61	11.8
Series B.								
Check	0	6.7	0	10.9	--	---	--	---
6 pts.-ac.	100	47.2	72	26.3	--	---	--	---
Series C.								
Check	0	3.6	0	11.2	--	---	--	---
6 pts.-ac.	72	23.0	84	19.3	--	---	--	---

Rate of Applying 2,4-D in Several Forms to Annual Weeds in Spring Barley At Crookston, Minnesota. NCWCC Unif. Exp. No. II. 1947.

L. M. Stahler, and R. S. Dunham.(1)

Spray applications of the butyl ester, triethanolamine, and monohydrate sodium salt of 2,4-D, at 1/4, 1/2, and 3/4 pounds acid per acre were made on triplicate, randomized, 1/25 acre plots of Mars barley on June 25, 1947. Applications were made with an experimental model field sprayer. Applications were at a uniform rate of 10 gallons per acre. Barley was uneven, 5 to 16 inches high and in the shooting to boot stage. Barley was heavily infested with sow thistle in rosette to shooting stage, mustard in rosette to bloom and buckwheat in 4 leaf to twining stage. Also heavy infestation of wild oats. Soil moisture was ample throughout the season.

All formulations at all concentrations gave practically 100% elimination of mustard and wild buckwheat. Sow thistle was controlled-did not bloom-on all treated plots but final kill cannot be determined until spring of 1948. At lowest rates of application of all formulations some buckwheat was not completely killed but was completely controlled and produced no seed. Sow thistle deteriorated very slowly at lower rates of application, and reacted to all ester formulations more rapidly than to the amines or sodium salts.

Barley on plots treated with esters at 1/2 and 3/4 pounds was markedly dwarfed in height and head size. Fields of barley were reduced by all formulations at 3/4 pounds per acre-the esters cutting yields almost 50 %. Average yields of plots treated with 1/2 pound of all formulations were only slightly reduced; at rates of 1/4 pound per acre were only equal to untreated check plot yields. Quality of barley as measured by bushel weight was not affected by any treatment. Germination tests of barley seed are not yet available. Attached table gives summary data.

(1) Agronomist, Bureau Plant Ind., Soils & Agric. Engr., U.S.D.A., and Professor, Agronomy Division, College of Agric., Univ. of Minn., St. Paul, Minnesota.

Summary of data on rates of applying several formulations of 2,4-D, at 10 gallons per acre on annual weeds in Mars barley. N.C.W.C.C. Univ. Exp. No. II. Crookston, Minnesota, 1947. Data are the average of triplicate treatments made on June 25, 1947.

Types of 2,4-D used	Pounds per acre 2,4-D (acid)	Percent kill of weeds 7/21/47. Mustard.	Wild buckwheat.	Effect on barley Field in bu.-ac.	Bushel weight in pounds
Butyl ester	3/4	99	96	10.9	46.5
Triethanolamine	3/4	99	94	16.9	46.5
Sodium salt	3/4	99	96	17.5	47.0
Average all forms		99	95	15.1	46.6
Butyl ester	1/2	99	98	18.0	47.0
Triethanolamine	1/2	99	98	19.8	46.0
Sodium salt	1/2	99	96	18.9	46.5
Average all forms		99	97	18.9	46.5
Butyl ester	1/4	99	94	19.6	47.5
Triethanolamine	1/4	99	90	19.0	46.5
Sodium salt	1/4	99	92	19.1	47.0
Average all forms		99	92	19.2	47.0
		(No. plants per sq. yard)			
Average untreated checks.....		28	9	19.3	46.5

(1) Sherwin William's Butyl ester; Standard's Triethanolamine; DuPont's Monohydrate sodium salt.

Rates of Applying Several Forms of 2,4-D For The Control of Annual Weeds in Durum Wheat. (NCWCC Unif. Exp. No. II, 1947

L. M. Stahler, and E. A. Helgeson.(1)

Spray applications of the butyl ester, triethanolamine salt and monohydrate sodium salt of 2,4-D at 1/4, 1/2, and 3/4 pounds acid per acre were made on triplicate, randomized, 1/25 acre plots of durum wheat on June 23, 1947. Applications were made with an experimental model field sprayer. Applications were at a uniform rate of 10 gallons per acre. Wheat was 4 to 8 inches tall, mustard in 2 leaf to first bud, frenchweed in 2 leaf to first bud, buckwheat 1 to 4 leaf stage, lambsquarters 4 to 6 leaf stage. Grain and weeds in rapid growing stage at date of treatment. Following treatment soil was very dry to harvest.

All formulations at all rates of application gave practically 100 % elimination of mustard, frenchweed, buckwheat and lambsquarters. Some buckwheat at lowest rates of application of all formulations remained partly green but was drwrfed and did not produce seed. Wheat on all plots, except the two higher rates of the butyl ester was slightly taller than the untreated check plots where the heavy infestation of weeds coupled with the drougth conditions dwarfed the plants and reduced the yield of wheat as shown in the following summary table. Wheat on plots treated with 1/2 or 3/4 pounds of butyl ester showed dwarfing of stems and shorter heads than untreated areas.

Wheat yields were increased by all treatments. Applications of 1/4 pound per acre of all formulations gave highest average yield increase. Quality of wheat as reflected in bushel weight, was not effected by any of the treatments. Germination data are not yet available.

(1) Agronomist, Bureau Plant Ind. Soils & Agric. Engr., U S.D.A., and Head of Botony Dept., Agric.Exp. Station, Fargo, North Dakota, respectively.

Summary of data on rates of applying several formulations of 2,4-D, at 10 gallons per acre on annual weeds in durum wheat. N.C.W.C.C. Unif. Exp. No. II. Devils Lake North Dakota, 1947. Data are the average of triplicate treatments made on June 23.

Type of 2,4-D used. (1)	Pounds per acre (acid)	Per cent kill of weeds 7/20/47. Mustard,	Frenchweed,	Lambsquas,	Buck-wheat.	Effect on wheat. Field in bu. per acre	Bushel wt. lbs.
Butyl ester	3/4	99	99	99	99	11.6	59.5
Triethanolamine	3/4	99	99	99	99	13.8	59.8
Sodium salt (monohyd.)	3/4	99	99	99	99	12.5	59.6
Average-all forms		99	99	99	99	12.6	59.6
Butyl ester	1/2	99	99	99	99	12.0	59.8
Triethanolamine	1/2	99	99	99	99	13.4	59.6
Sodium salt	1/2	99	99	99	99	12.9	60.0
Average all forms		99	99	99	99	12.8	59.8
Butyl ester	1/4	99	99	99	96	13.7	60.1
Triethanolamine	1/4	99	99	94	95	13.5	59.8
Sodium salt	1/4	99	99	96	92	13.4	59.9
		(No. plants per sq. yard)					
Average untreated checks		64	52	4	5	6.1	59.8

(1) Sherwin-Williams Butyl ester; Standard's Triethanolamine; DuPont's Monohydrate sodium salt.

Response of flax varieties to 2,4-D--Tandon, R. K. and R. S. Dunham

This study was designed to determine if there is any differential response between 7 commonly grown varieties of flax to applications of the sodium salt, the amine salt, and the ester of 2,4-D at rates of 4, 8, and 16 ozs., acid equivalent per acre. The varieties tried were: Crystal, Dakota, Koto, Minerva, Redwing, Sheyenne, and B 5128. There were4 replications, making a total of 336 plots.

The plots consisted of three 18-foot rows of which a 16-foot lenght of central row was harvested for the yield of grain and straw. The rows were sown 1 ft. apart so that weeds could be controlled by hoeing. The herbicides were sprayed when the seedlings were 5"-8" tall.

Data collected consisted of growth rate, blooming and maturity dates, degree and percentage of lodging, and yield of grain and straw. Germination tests and determination of oil percentage and iodine values are in progress. A statistical analysis of the data has not been completed at this time but varietal differences are indicated with a trend toward greater tolerance in Redwing and Koto and greater susceptibility in Crystal and B 5128. Minerva, Dakota, and Sheyenne occupy an intermediate position. Straw yields and agronomic data are not available at this time.

Varieties	Check	Sodium			Amine			Ester		
		4 oz.	8 oz.	16 oz.	4 oz.	8 oz.	16 oz.	4 oz.	8 oz.	16 oz.
Cyrstal	23.4	21.7	22.9	18.9	21.8	20.1	19.1	20;8	17.8	14.8
Dakotas	27.0	30.2	30.1	21.1	27.1	27.1	21.7	25.2	22.6	21.5
Kota	26.3	26.1	25.8	25.4	25.9	22.9	23.0	24.8	25.3	21.6
Minerva	25.4	26.0	24.3	23.0	25.8	23.8	21.7	22.6	20.6	20.3
Redwing	27.9	28.3	28.4	27.2	27.9	28.7	26.6	27.6	25.2	24.4
Sheyenne	24.6	24.5	25.4	22.6	26.2	25.1	20.9	23.7	22.6	21.3
B 5128	20.9	19.2	19,3	18.5	18.8	19.2	17.3	15.7	15.6	12.5

University of Minn., St. Paul, Division of Agronomy and Plant Genetics.

Uniform Experiment II-Rate of Applying 2,4-D and other selective herbicides on annual Weeds in Oats and Flax.

Summary of Results

Selective herbicide applications on replicated plots of oats and flax have given disappointing results on certain weeds at the rates used. The main weeds Comn Spurrey (Spergula arvensis L.), Lady's Thumb (Poly gonum Persicaria L.) and Wild Buck-

wheat (Poly gonum convolvulus L.) were poorly controlled by various preparations of 2,4-D at rates up to 1 lb. 2,4-D acid per acre. There were indications that the dinitro sprays at the recommended rates were more successful than 2,4-D in the control of these weeds. Although some treatments gave increased yields of grain and straw over the check none of these were significantly higher at the 5% level.

The ester and dust forms of 2,4-D at 0.5 and 1.0 lb. 2,4-D acid per acre caused noticeable damage to the flax. Considerable leaf tip damage to the oat plants was evident immediately after spraying with ammonium dinitro secondary butyl phenate, however recovery seemed complete within a month.

D. K. Taylor-Dominion Experimental Farm-Agassiz, B.C. 1947.

Uniform Experiment II-Rate of Applying 2,4-D and other Selective Herbicides on Annual Weeds in Oats-Conducted by the Dominion Experimental Farm, Agassiz, B.C.,1947.

Types 2,4-D	Commercial Preparation	Rate of 2,4-D per acre (lb.)	Yield per ac. (bu.)	Height of plant (in.)	Weed Control Corn Spurrey (%)	Lady's Thumb (%)
			AVERAGE			
Amine	2,4-Dow Weed	.36	40.9	39.0	-1	37
Amine	Killer	.72	49.3	40.0	11	18
Amine	Killer	1.45	49.5	38.7	10	41
Ester	Esteron 44	.25	37.7	38.3	10	24
Ester	Esternon 44	.50	35.8	35.5	4	7
Ester	Esternon 44	1.00	30.6	35.7	10	16
Sodium	2,4-Dow Weed	.25	40.4	37.7	19	13
Salt	Killer	.50	37.7	34.7	6	29
Salt	Killer	1.00	34.2	33.7	2	34
Dust	Esternon # 30	.25	38.8	37.7	14	10
Dust	Esternon # 30	.50	39.8	38.0	9	26
Dust	Esternon # 30	1.00	45.1	39.0	4	36
	Dow Selective	3.10	44.5	37.0	69	57
	Sinox X	3.70	44.6	37.7	14	16
	Check		34.4	37.3	0	0

x- Sinox lower than the recommended rate, plus 2# $(NH_4)_2SO_4$
No significant differences in yield.
Plots 55 1/2 sq. ft.-2 rod rows harvested for yield, 4 replications.
Date of applications-May 27. Corn Spurrey 2-5", Lady's Thumb 1-3". Temperature 70°, Humidity 85°, First rain- 3 days later. Recount-July 2.

Uniform Experiment II-Rate of Applying 2,4-D and other Selective Herbicides on Annual Weeds in Flax-Conducted by the Dominion Experimental Farm, Agassiz, B.C.,1947.

Types of 2,4-D	Commercial Preparation	Rate of 2,4-D (lb.)	Yield Per Acre Total plant lb.	Crude fibre (lb.)	Seed (bu.)	Height of Plant (in.)	Strength of Straw (1-10)	Weed Control Corn Spurrey (%)	Lady's Thumb (%)
Amine	2,4-Dow	.36	2066	1343	7.1	32.5	9.5	4	25
"	Weed Killer	.72	1857	1218	6.5	31.7	9.5	17	31
"		1.45	2372	1513	9.1	31.3	9.5	24	-11
Ester	Esteron 44	.25	1877	1238	6.7	32.3	9.3	7	31
"		.50	2095	1381	7.3	31.3	9.3	14	22
"		1.00	2071	1358	7.3	29.5	8.5	3	19
Sodium	2,4-Dow	.25	2624	1715	10.0	32.7	9.7	9	29
Salt	Weed Killer	.50	1775	1164	6.6	31.0	9.7	13	20
"	"	1.00	2270	1463	8.7	32.3	9.7	9	10
Dust	Esteron 30	.75	2003	1300	7.1	31.7	9.3	20	33
"	"	.50	2008	1331	6.5	29.7	9.0	9	25
"	"	1.00	2139	1358	7.5	30.5	8.5	43	13
	Dow Selective	3.10	2454	1564	9.5	33.7	9.3	54	55
	Sinox	3.70	2711	1762	10.1	33.7	9.3	28	32
	Check		2243	1471	8.2	33.0	9.5	0	0

S.E. m Diff.	3100	493.2	1.31
Sig. Diff.(.05)	none	none	2.6

x-Sinox lower than the recommended rate, plus 2# $(NH_4)_2 SO_4$
Plots 55 1/2 sq. ft. 2 Rod rows harvested for yield, 4 replications, Date of applications-May 28-Flax 5-7", Corn Spurrey 2-3" Lady's Thumb 1-2", Temperature 64°, Humidity 78, Overcast, 1st rain 2 1/2 days. Recount-July 2.

Rate of Applying 2,4-D and Other Selective Herbicides for the Control of Annual Weeds in Winter Barley (NCWCC Uniform Exp. No. II. 1947) F. L. Timmons (1)

Spray applications of the triethanolamine salt and the isopropyl ester of 2,4-D at 1/4, 1/2, and 1 pound per acre (acid basis) and of Dow Selective Herbicide at 2.2 pounds of dinitro salt per acre were made May 13, 1947, on a thin stand of Reno winter barley. The crop was 4-6 inches tall and heavily infested with Russian thistle, rough pigweed, sunflower, and lambsquarters in early stages of growth. All treatments were replicated five times.

The ester of 2,4-D gave better kills of weeds and retarded the growth of barley more than did the amine salt. The percentages of weeds killed by the ester at 1/4 pound per acre were 74, 77, 94, and 100, respectively, of Russian thistle, pigweed, sunflower, and lambsquarters, as compared with 32, 50, 70, and 82, respectively, for the amine at 1/4 pound per acre. Dow Selective Herbicide gave excellent kills of all 4 weeds but severely burned the barley foliage. Barley yields averaged 58.9 bushels per acre for the amine salt treatments, 56.5 for the ester treatments, and 49.9 for Dow Selective Herbicide as compared with 55 bushels per acre for the untreated controls. The highest yields were 62.4 bushels per acre for the amine at 1 pound per acre and 59.2 for the ester at 1/2 pound per acre. More important than the small increases in yield due to 2,4-D was the fact that harvesting the crop with a combine was possible only on sprayed areas where the weeds had been controlled.

(Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A., cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station.

Summary of data on rate of applying 2,4-D and other selective herbicides on annual weeds in winter barley. NCWCC Uniform Exp. No. II, 1947 conducted at Hays, Kansas. All data are averages of five replications.

Type of 2,4-D or dinitro product used. Trade name in ()	Lbs. per A. of 2,4-D or dinitro	% kill of Weeds 6-18-47 Russian thistle	Pig-weed	Sun-flower	Lambs-qts.	% injury to crops 6-18-47	Yields of crop Bus/A	% of untreated controls
Triethanolamine salt of	.25	32	50	70	82	0	57.2	104
2,4-D	.50	56	84	93	100	6	57.0	103
(Ded-Weed 40)	1.0	64	86	94	100	4	62.4	113
	Average	51	73	86	94	3	58.9	107
Iso-propyl ester of 2,4-D	.25	74	77	94	100	0	53.7	98
(Dow Esteron 44)	.50	80	93	95	100	20	59.2	108
	1.0	96	100	99	100	20	56.5	103
	Average	83	90	96	100	13	56.5	103
Ammonium dinitro orth secondary butyl phenol (Dow Selective Herbicide)	2.2	97	89	88	100	40	49.9	91
Untreated Controls		-	-	-	-	-	55.0	100

ABSTRACT

Experiment II. Effect of various dosages of 2,4-D on five species of winter annual weeds growing in Intermediate Wheatgrass.

Glenn Viehmeyer, Horticulturist, Unv. of Nebraska Sub-Station, North Platte, Nebraska

Firle scale application of four formulations of 2,4-D, Amine and Sodium salts and Butyl and Ethyl esters, at .8, .4, .2, and .1 lbs. per acre was made May 14-16, '47, on Wild lettuce (Lactuca scariola L.), Fleabane (Erigeron canadense L.), Evening primrose (Oenothera spp.), Stick-seed (Lappula spp.) and Annual peppergrass (Lepedium apetalum). Weather was cool and light precipitation occurs on the nights of May 14, 16 and 18.

Under conditions prevailing at the time the esters were approximately four times as effective as the salts on the five species of weeds treated.

At time of treatment stage of growth was for lettuce rapid growing prebud; fleabane rapid growing prebus; primrose, first Bloom; stickseed, bud, peppergrass, full bloom and wheatgrass, early jointing.

Minimum effective dosages were, for lettuce, .1 lb. ester .4 lb. salt, fleabane, .1 ester, .4 salts; stickseed, .2 ester no control by salts; primrose, .1 ester .1 salts; peppergrass, .2 esters .8 salts and wheatgrass, no injury from any application.

The greater toxicity of the esters may be, in part, due to unfavorable weather conditions at application but not all difference was chargable to this factor. This conclusion is supported by many other experiments with both weeds and crops.

The experiment indicates that dosages of the esters lower than those generally recommended are effective in controlling the weeds named.

Table II. Effect of various 2,4-D formulations, at four dosages, on winter annual weeds. (Final data taken August 1, 1947)

Formulation	Dosage lbs. per acre	Wild lettuce		Canada Fleabane		Stickweed		Evening Primrose		Peppergrass	
		Kill	Control	Kill	Con.	Kill	Con.	Kill	Con.	Kill	Control
Sodium salt	.8	3	6	1	6	0	1	6	6	3	4
Amine salt	"	5	6	1	6	0	2	6	6	3	4
Ethyl ester	"	6	6	6	6	5	6	6	6	6	6
Butyl ester	"	6	6	6	6	5	6	6	6	6	6
Sodium salt	.4	1	5	0	5	0	2	6	6	2	4
Amine salt	"	3	5	1	5	0	2	6	6	2	4
Ethyl ester	"	6	6	6	6	5	6	6	6	6	6
Butyl ester	"	6	6	6	6	5	6	6	6	6	6
Sodium salt	.2	1	4	0	5	0	0	4	6	0	1
Amine salt	"	1	4	0	5	0	0	4	6	0	1
Ethyl ester	"	5	6	4	5	2	5	5	6	5	5
Butyl ester	"	5	6	4	5	2	5	5	6	5	5
Sodium salt	.1	1	2	0	2	0	0	0	4	0	0
Amine salt	"	1	2	0	2	0	0	0	5	0	0
Ethyl ester	"	4	5	1	5	0	4	5	6	1	3
Butyl ester	"	4	5	2	5	0	4	5	6	1	3
Untreated check	none	0	0	0	0	0	0	0	0	0	0

Index No.	Amount of Kill	Percent	Index N.	Degree of Control Secured	Percent
0		0	0		0
1		1 to 20	1		1 to 20
2		21 to 40	2		21 to 40
3		41 to 60	3		41 to 60
4		61 to 80	4		61 to 80
5		81 to 99	5		81 to 99
6		100	6		100

Killing Weeds in Plots of Wheat, Oats, Barley and Flax with 2,4-D : H. E. Wood, G. R. Fraser

Square rod plots of wheat, oats, barley and flax were treated at four locations. The four crops were seeded side by side on land known to contain a heavy infestation of annual weed seeds. Three formulations--sodium salt, ester, and amine salt--were applied with knapsack sprayer at concentrations of 4, 8, and 16 ounces acid in water, 120 U.S. gall. per acre; also a dust of 2,4-D was applied at similar acid concentrations, when the grain was 6 to 10 inches in height, the weeds two leaves to budding.

Almost complete eradication of the predominating weed, wild mustard (Brassica arvensis), was obtained throughout with the sprays; dusts at 4 ounces gave less satisfactory kills. At the 4 ounce concentration, sodium salt and the dusts were likewise less satisfactory on the other weed growth, which included giant ragweed (Ambrosia trifida), stinkweed (Thlaspi arvense), lambs-quarters (Chenoposium album), red-root pigweed (Amaranthus retroflexus). Wild buckwheat (Polygonum Convolvulus) showed slight "stunting".

The effect on the grain crops, even at the highest concentration was slight; flax appeared to be retarded rather severely at the 8 and 16 ounce concentrations, particularly with the ester; severe burning of the leaves and twisting of the stem was quite evident. No yield data were taken from these plots.

Contributed by: The Weeds Commission, Manitoba Department of Agriculture.
Winnipeg, Manitoba

Killing Weeds in Fields of Wheat, Oats, Barley and Flax, with 2.4-D
H. E. Wood, G. R. Fraser

Supplementary to plot trials were strips one rod wide, 20 rods long, in fields of wheat, oats, barley and flax, at the same four locations as the plots. A boom sprayer was used to apply the same three formulations at 8 ounces acid in 20 U.S. gal. water per acre. Weed infestation was comparable to, and control similar to that obtained in the plots. Three randomized blocks of ten rows, ten feet in length, from both treated strips and checks were threshed and yields determined. With two minor exceptions, yield increases were obtained from all treated wheat and flax fields; oats and barley yields were so contradictory that no conclusions could be drawn (these two crops throughout the area gave "spotty" yields). Range of yield increases for wheat and flax, basis 100 for checks, was:

	Sodium Salt	Ester	Amine Salt
Wheat	103 to 153	105 to 120	90 to 167
Flax	95 to 129	99 to 142	135 to 188

Contributed by: The Weeds Commission, Manitoba Department of Agriculture.
Winnipeg, Manitoba.

Results of Uniform Experiment III - The Relative Susceptibility to 2,4-D of Annual and Winter Annuals at Different Stages of Growth

Regional Summary
Prepared by
Oliver C. Lee and L. F. Bewick[1]/

Reports submitted indicate the following trends:

1. Weeds were most susceptible to 2,4-D at early stages of growth. Their resistance increased gradually with growth and maturity with a sharp increase in resistance noted after the bud stage.

2. Little difference could be determined between the effectiveness of the different formulations of 2,4-D when applied at early stages of growth. However, the esters showed an increase in effectiveness over the salts in direct relation to the maturity of the weed.

Reports of Individual Investigators

Effect of Seven Different Type Formulations of 2,4-D at Six Dosage Levels on Plant Kill and Seed Formation of Cocklebur (Xanthium Commune)

Noel S. Hanson and Neal E. Shafer[2]/

An experiment was conducted at Lincoln, Nebraska to determine the lowest efficient dosage possible for the eradication or the prevention of seed set of cocklebur plants. Two replications of plants in the young bur-forming stage were treated on August 28 and 30, 1947. Five different ester formulations, one triethanolamine, and one sodium salt formulation were tested at six dosage levels of 1/8, 1/4, 1/2, 1, 1½ and 2 pounds acid equivalent per acre. Observations 24 hours after treatment showed typical 2,4-D curvature on all plots bur most intense at the higher dosages. Observations on October 15th indicated average kills of 85.0 per cent or above on all plots treated with 1/2 or more pounds per acre. Several kills of 90 per cent or more were obtained on plots treated with 1/8 and 1/4 pounds per acre. These kills were not consistent in both replications and, consequently, do not appear in the averaged data. Good control was obtained at 1/8 and 1/4 pounds per acre expressed in reduced bur set. No attempt was made to determine the reduction in burs on live plants, but mature burs were later collected from these plants and seed set determined. Twenty-five burs were cut open and seed counted. Few seeds were formed at dosages of 1/2 pound per acre or above. At 1/8 pound per acre an average of from 13.5 to 22.5 burs out of 25 had no seed, but 2.5 to 8.5 burs had one seed formed, and from 0.5 to 2.0 burs out of 25 had two seed set. The untreated plants had 22.0 per cent of the burs with no seed, 34.0 per cent with one seed, and 43.0 per cent with two seeds (Table 1).

1/ Extension Botanist, Purdue University, Research Fellow, Ohio State University, respectively.

2/ Assistant Agronomist and Graduate Assistant, Nebraska Experiment Station, Lincoln, respectively.

Table 1.
Effect of Different Types of 2,4-D at Several Dosage Levels on Plant Kill and Seed Formation of Cocklebur (Xanthium commune). (Average of two replications. Plants in young bur stage.) Lincoln, Nebraska.

2,4-D type Formulation	Dosage in lbs. acid equivalent per acre	Per cent kill of Plants	No. Seeds per bur (25)		
			0	1	2
	8/28-30/47	10/15/47	10/15/47		
Butyl ester 56%	1/8	56.0	13.5	8.5	0.5
" "	1/4	61.5	18.0	3.5	3.5
" "	1/2	95.0	16.5	4.0	5.0
" "	1	99.5	17.5	6.0	1.5
" "	1½	99.5	22.5	2.0	0.5
" "	2	100.0	25.0	0.0	0.0
Butyl ester 40%	1/8	90.0	22.5	2.5	0.5
" "	1/4	50.0	13.5	10.0	1.5
" "	1/2	90.0	22.5	1.5	1.0
" "	1	97.5	22.5	2.0	0.5
" "	1½	99.0	24.5	0.5	0.0
" "	2	100.0	24.5	0.5	0.0
Ethyl ester	1/8	52.5	16.5	6.5	2.0
" "	1/4	60.0	17.5	5.0	2.5
" "	1/2	91.5	14.0	7.5	3.5
" "	1	88.5	16.5	5.5	3.0
" "	1½	96.5	16.0	6.0	3.0
" "	2	99.0	25.0	0.0	0.0
Iso propyl ester	1/8	60.0	21.0	3.0	1.0
" "	1/4	57.5	14.0	8.5	2.5
" "	1/2	95.0	18.0	4.0	3.0
" "	1	99.0	19.0	3.0	3.0
" "	1½	100.0	22.0	1.5	1.5
" "	2	100.0	25.0	0.0	0.0
Methyl ester	1/8	95.0	20.0	3.5	1.5
" "	1/4	67.5	21.0	3.0	1.0
" "	1/2	85.0	16.0	4.5	4.5
" "	1	91.5	22.0	1.5	1.5
" "	1½	99.0	21.0	2.5	1.5
" "	2	100.0	21.5	1.5	2.0
Amine Salt	1/8	82.5	20.5	3.0	1.5
" "	1/4	94.0	21.5	3.0	0.5
" "	1/2	97.5	21.0	2.5	1.5
" "	1	97.5	23.5	1.5	0.0
" "	1½	99.5	24.5	0.5	0.0
" "	2	100.0	25.0	0.0	0.0
Sodium Salt	1/8	52.5	18.5	5.0	1.5
" "	1/4	75.0	22.0	1.5	1.5
" "	1/2	75.0	18.0	3.5	3.5
" "	1	99.0	25.0	0.0	0.0
" "	1½	100.0	23.5	0.5	1.0
" "	2	100.0	25.0	0.0	0.0
Check	0	0.0	5.5	8.5	11.0
			22%	34%	43%

Approximately 600 plants per square rod on the untreated area and more than 150 burs per plant.

Stinkweed (Thlaspi arvense)

A. C. Carder[1]/

Treatments were applied to a heavy infestation of stinkweed (Thlaspi arvense) in growing spring wheat. Applications were made under as favorable conditions as possible, though these were never entirely optimum. Low humidity and relatively low temperatures prevailed at the time of the first two treatments. Plots were duplicated.

The most effective treatments were secured when the weed was in a seedling stage of several true leaves, or at least before budding. The ester formulation was, in every instance, the most effective, though at the earlier growth stages of the weed its advantage was very slight over the sodium salt. Possibly the more rapid action of the ester accounts for its greater effectiveness over the salt when both were applied at the later stages of growth. Somewhat better kills were obtained by the .1 per cent, or heavier concentration.

1/ Assistant, Department of Agriculture, Alberta, Canada.

Killing Purslane (Portulaca oleracea) with 2,4-D

C. R. Ure

During 1946-47, 33 plots densely infested with purslane were sprayed with three formulations -- sodium salt, ester, and amine salt -- at concentrations ½ to 2 pounds acid per acre, at various stages of growth. Although not the easiest of annuals to eradicate with 2,4-D, purslane was almost completely killed with the ester and amine salt formulations at concentrations of one-half pound upward in the pre-bud and bud stages. In the flowering stage it showed marked resistance; the butyl ester at two pounds gave a 75% reduction in stand. Except at a concentration of 2 pounds acid in the pre-bud and bud stage when 30-35% reduction in stand was obtained, sodium salt was quite ineffective.

Contributed by: Dominion Experimental Station, Morden, Manitoba.

Killing Stinkweed (Thlaspi arvense) with 2,4-D

H. E. Wood and G. R. Fraser

During 1945-47, in addition to 33 plots sprayed, observations were made on many other field plots and grain fields treated commercially. This weed was readily killed either as a winter survivor or in the spring emerged form, at all stages to a point where seed formation commenced, thereafter, it became quite resistant. As a winter annual sprayed in early spring in flower at 4 ounces acid per acre concentration, sodium salt gave 50% kill, ester 100% kill. On spring growth in pre-bud, 4 ounces gave for sodium salt 83% kill; amine salt 92% kill; 1 pound gave 100% kill all formulations (Table II).

Plots with Dense Infestation Purslane
Treated in 1947 at the Dominion Experimental Station, Morden, Manitoba

Formulation & Concentration		Estimated Reduction in Percent		
		Pre-bud July 15	Bud July 22	Flower Aug. 2
Ester - Weed-No-More 40	2 lbs.	99	99	75
	1 lb.	99	95	50
	8 ozs.	99	15	8
Ester - Dow's Esteron 44	2 lbs.	99	95	70
	1 lb.	90	85	30
	8 ozs.	75	12	5
Sodium Salt - Chipman's	2 lbs.	80	35	30
	1 lb.	70	35	25
	8 ozs.	50	10	5

Contributed by: The Weeds Commission, Manitoba, Department of Agriculture.

Killing Cocklebur (Xanthium orientals) with 2,4-D

H. E. Wood, and G. R. Fraser

On limited trials (4 plots) during 1946, this weed was very readily killed with all formulations at .1% concentration. To test company products, a very low concentration (2 oz. acid per acre) was applied to dense stands of this weed, July 16, 1947, when the plants were in the pre-bud stage (3 to 6 inches high); kills ranged from a low of 45% to 95%.

Reported by: The Weeds Commission, Manitoba Department of Agriculture.

Killing False Ragweed or Marsh Elder (Iva zanthifolia) with 2,4-D

H. E. Wood and G. R. Fraser

On 25 plots treated 1945-47, with all formulations, with concentrations 8 to 16 ounces acid per acre, this weed in the active growing stage has been very readily killed. However, as the plant approaches the seed setting stage it becomes quite resistant.

Contributed by: The Weeds Commission, Manitoba Department of Agriculture.

The Relative Susceptibility to 2,4-D of Four Annual Weeds at Different Stages of Growth (NCWCC Uniform Exp. No. III, 1947)

F. L. Timmons[1]/

Duplicated spray applications of the isopropyl ester and the triethanolamine salt of 2,4-D were made at rates of .5, 1.0, and 1.5 pounds per acre (acid basis) on Russion thistle (Salsola pestifer), Lamsquarters (Chenopodium album), rough pigweed (Amarantus retroflexus), and sunflower (Helianthus annuus) at 3 to 6 different stages of growth from emergence to bloom or early seed. The .5 pound rate was omitted in the last applications on all four weeds and the 1.5 pounds-per-acre rate was omitted in the first two applications on Russian thistle and lambsquarters.

The ester was much more effective on all four weeds than the amine salt at equivalent rates and gave better kills of Russian thistle and lambsquarters at .5 pound per acre than the amine salt at 1.0 or 1.5 pounds per acre. Russian thistle showed increasing resistance to 2,4-D after the seedling stage and was not effectively controlled after the early growth stage. Rough pigweed was effectively controlled by the ester at 1.0 pound per acre in all stages except early seed and was partially controlled by the amine at 1.5 pounds per acre. Lambsquarters was highly susceptible to the ester at all rates before the early seed stage and was controlled fairly well by the amine at the heavier rates before the bloom stage. Sunflower was highly susceptible to both types of 2,4-D formulations at bloom and earlier stages. (Table III)

The Relative Susceptibility to 2,4-D of Four Annual Weeds at Different Stages of Growth (NCWCC Uniform Exp. No. III, 1947)

F. L. Timmons[1]/

Duplicated spray applications of the isopropyl ester and the triethanolamine salt of 2,4-D were made at rates of .5 and 1.0 pound of 2,4-D acid equivalent per acre on treacle mustard (Erysimum repandum) and tansy mustard (Descurainia intermedia) at early bloom, full bloom, and early seed stages of growth, and on Canada fleabane (Erigeron canadensis) and western wild lettuce (Lactuca ludoviciana) at six different times from the rosette to bud or blossom stage of growth. Both chemicals were applied also at 1.5 pounds of 2,4-D per acre on all weeds at late stages of growth.

The ester was much more effective on all four weeds than the amine salt at equivalent rates. The ester at .5 pound of 2,4-D per acre was as effective as the amine salt at 1.0 or 1.5 pounds of 2,4-D per acre. All four weeds showed increasing resistance to 2,4-D as they became more mature. The ester at .5 pound and the amine salt at 1.0 pound per acre (acid basis) gave satisfactory control of all four weeds in early stages of growth and of the mustards in early bloom. Both chemicals were relatively ineffective on the mustards or wild lettuce in the early seed stage or on Canada fleabane after the shooting stage even when they were applied at rates up to three pounds per acre. Results indicated that for effective and economical control with 2,4-D Canada fleabane must be sprayed while the plant is in the rosette stage. (Table IV)

1/ Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering U.S.D.A., cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station

Table III

Summary of data on the relative susceptibility to 2,4-D of four annual weeds at different stages of growth. NCWCC Uniform Exp. III, 1947 conducted at Hays, Kansas. Data shown are averages of two replications of all treatments as compared with untreated controls.

Kind of weed	Dates of spraying	Stage of growth when sprayed: Height (inches)	Stage of growth when sprayed: Maturity	Percent kill of weeds by different 2,4-D products at specified rates of 2,4-D per acre: Tufor E (1) .5 lb.	Tufor E (1) 1.0 lb.	Tufor E (1) 1.5 lbs.	Weedar (2) .5 lb.	Weedar (2) 1.0 lb.	Weedar (2) 1.5 lbs.
Russian thistle (Salsola pestifer)	Apr. 14	-	Emerging 2-4 leaves	70	70	-	40	65	-
	Apr. 28	½- 2	2-8 leaves	88	95	-	50	70	-
	May 13	1- 3	Fully emerged	85	90	100	0	50	50
	June 2	2- 8	Early growth	60	55	80	10	20	35
	June 21	4-12	Early growth	45	70	75	5	15	15
	July 8	8-16	Rapid growth	-	10	50	-	0	25
	July 25	10-24	Pre bud to bloom	-	0	0	-	0	0
Lambsquarters (Chenopodium album)	Apr. 14	-	Emerging	70	97	-	65	75	-
	Apr. 28	¼- 1	2-8 leaves	100	100	-	90	80	-
	May 13	1- 6	Fully emerged	100	100	100	30	90	95
	June 2	6-12	Rapid growth	100	100	100	25	75	95
	June 21	24-36	Bloom	93	98	100	35	40	75
	July 8	36-60	Early seed	-	10	55	-	0	25
Rough pigweed (Amaranthus retroflexus)	May 13	½- 1	Emerging 2-8 leaves	50	80	90	10	80	60
	June 2	1- 6	Fully emerged	40	90	85	0	35	90
	June 21	6-16	Some bloom	50	100	100	30	30	50
	July 8	12-24	Early seed	-	20	85	-	30	70
Sunflower (Helianthus annuus)	June 2	12-18	Rapid growth	90	100	100	100	90	100
	June 21	24-36	Some buds	90	100	100	75	90	100
	July 8	36-60	Bloom	-	95	100	-	95	100

(1) The active ingredient in Tufor E is the iso-propyl ester of 2,4-D.
(2) The active ingredient in Weedar is the triethanolamine salt of 2,4-D.

Table IV
Summary of data on the relative susceptibility to 2,4-D of four winter annual weeds at different stages of growth. NCWCC Uniform Exp. III, 1947 conducted at Hays, Kansas. Data shown are averages of two replications of all treatments as compared with untreated controls.

Kind of weed	Stages of growth when sprayed			Percent kill of weeds by different 2,4-D products at specified rates of 2,4-D per acre					
				Tufor E (1)			Weedar (2)		
	Dates of spraying	Height (inches)	Maturity	.5 lb.	1.0 lb.	1.5 lbs.	.5 lb.	1.0 lb.	1.5 lbs.
Treacle mustard (Erysimum repandum)	Apr. 14	2- 6	Some bloom	95	99	-	85	95	-
	Apr. 28	8-18	Full bloom	70	85	-	60	75	-
	May 13	8-18	90% of pods formed, some green seed	40	30	60	0	15	30
Tansy mustard (Descurainia intermedia)	Apr. 14	1- 5	Some bloom	97	99	-	65	93	-
	Apr. 28	3-10	Full bloom	70	80	-	40	60	-
	May 13	3-10	90% pods formed, some green seed	10	10	40	0	0	10
Canada fleabane (Erigeron Canadensis)	Apr. 14	1- 3	Rosette	93	99	-	70	88	-
	Apr. 28	2- 4	Rosette	88	94	-	70	85	-
	May 13	2-10	Mostly rosette	85	95	100	30	65	90
	June 2	8-18	Shooting	40	83	94	5	10	15
	June 21	24-36	Rapid growth	21	30	35	41	33	20
	July 8	36-60	Some buds	-	60	45	-	100	55
Western wild lettuce (Lactuca ludoviciana)	Apr. 14	2- 6	Rosette	93	100	-	40	100	-
	Apr. 28	4- 8	Rosette	90	100	-	60	80	-
	May 13	8-16	Shooting	100	100	100	35	95	100
	June 2	12-24	Shooting	85	100	100	20	20	50
	June 21	24-36	Bud to bloom	75	73	88	50	20	55
	July 8	36-60	Bloom to early seed	-	50	100	-	-	30

(1) The active ingredient in Tufor E is the iso-propyl ester of 2,4-D.
(2) The active ingredient in Weedar is the triethanolamine salt of 2,4-D.

The Relative Susceptibility to 2,4-D of Three Annual Weeds at Different Stages of Growth.

Oliver C. Lee[1/]

Applications of esters and sodium salt of 2,4-D were made at rates of .25, .5, 1.0, and 1.5 pounds per acre (acid basis) on common ragweed (Ambrosia elatior), giant ragweed (Ambrosia trifida), and cockle bur (Xanthium commune) in four stages of growth.

The ester produced a quicker kill of all species in all stages of growth than did the sodium salt. In the early stages of growth lesser amounts of the ester were required for complete kills. In the seedling and rapid growth stages both species of ragweed were quite consistantly killed with .5 pounds of 2,4-D especially when an ester was used. About 1 pound per acre is required to kill cocklebur, in stages of growth up to maturity. It was also noted that .25 to .5 pounds, to a large extent, reduced seed production of cocklebur and ragweed (both species) when applied in the blossom stage of growth. (Table V).

Table V. Data showing susceptibility of three weeds to 2,4-D Ester and Sodium Salt, Average of 3 Replications

Weed	Maturity	Height	Percent kill with pounds per acre							
			Sodium Salt				Ester			
			0.25	0.5	1.0	1.5	.25	0.5	1.0	1.5
C. Ragweed	Seedling	6 in.	82	88	100	100	94	100	100	100
(Ambrosia	Rapid growth	12 in.	76	88	93	100	70	90	100	100
Elatior)	Bud	24 in.	75	84	93	100	72	96	100	100
"	Bull bloom	24 in.	52	70	48	69	38	47	70	86
Giant	Seedling	6 in.	40	48	100	100	62	84	100	100
Ragweed	Rapid Growth	30 in.	42	61	100	100	64	80	100	100
(Ambrosia	Bud	48 in.	10	47	90	100	0	70	100	100
trifida)	Fullbloom	56 in.	0	0	12	40	1	14	64	62
Cocklebur	2 leaves	3 in.	40	68	100	100	48	64	100	100
(Xanthium	Rapid growth	8 in.	31	71	100	100	30	78	100	100
commune)	Early blossom	22 in.	22	20	96	89	24	48	100	100
"	Full bloom	24 in.	0	10	89	100	0	42	96	100

Note: Plants emerging after early spray applications are not considered in determining percent kill.

1/ Extension Botanist, Purdue University, Lafayette, Indiana

RESULTS OF NON-UNIFORM AND MISCELLANEOUS EXPERIMENTS
Compiled ~~COMPLETED~~ BY W. C. DUTTON
USE OF 2,4-D FOR CHEMICAL SUMMERFALLOW

T. K. Pavlychenko
Laboratory of Plant Ecology
University of Saskatchewan

On July 18, 1946 four 6' x 12' plots were treated with methyl ester at the rates ½, 1, 1½ and 2 lbs. of acid equivalent per acre. In addition a field one acre in size was sprayed with 1½ lbs. per acre of the same chemical. The plots and the field were heavily polluted (130 to 450 plants a sq. yd.) with Wild Mustard (Sinapis arvensis) and Stinkweed (Thraspi arvense). Counts were made every 30 days after the treatments and late in May, 1947. The results were as follows:

Non-uniform

Chemical	Rate ounces/ acre	Percent reduction of original stand Days after treatment 30	60	90	May 1947
Dow ester G 652	8	100	100	92[x]	62[xx]
6' x 12' plots	16	100	100	99	64
	24	100	100	99	77
	32	100	100	100	73
one acre field	24	100	100	97	86

[x] some seedlings of Russian thistle emerged in late September and survived till the freeze up.

[xx] Mostly Russian thistle, red root pigweed, wild mustard and stinkweed make less than 10% of the new growth.

THE EFFECT OF INTENSIVE CULTIVATION OF FIELD BINDWEED BEFORE AND AFTER SPRAYING WITH 2,4-D ON EFFICIENCY IN ERADICATION

F. L. Timmons (1)

An experiment comparing 2,4-D spraying alone, intensive cultivation alone, and four different combinations of the two as methods of eradicating bindweed was started at Hays, Kansas in the the spring of 1947. The four combination methods included:

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(1) Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A., cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station.

intensive cultivation after spraying with 2,4-D in early spring; and intensive cultivation 1, 2, and 3 months, respectively, before spraying with intensive cultivation as needed after spraying with 2,4-D.

Results to date from the uncompleted experiment show no advantage for intensive cultivation either before or after spraying with 2,4-D. A single cultivation before spraying to eliminate grasses and other early starting weeds and conserve moisture appeared desirable. Emergence of bindweed plants after periods of intensive cultivation was slow and erratic and may not have been completed during the four to six weeds of growth before spraying. Intensive cultivation was not effective in eradicating the bindweed plants which survived treatment with 2,4-D. A single spraying with 2,4-D with no intensive cultivation reduced the stand of bindweed slightly more than did one season of intensive cultivation involving ten tillage operations. However, the amount of soil moisture conserved by the former was much less due to the growth of grasses and other annual weeds.

The Effect of Intensive Cultivation of Field Bindweed Before and After Spraying with 2,4-D on Efficiency in Eradication.

Summary of results recorded in 1947. All data are averages of duplicate plots.

Method Number	No. of cultivations, 1947 Before Spraying	No. of cultivations, 1947 After Spraying	Dates of spraying 1947	Bindweed plants per sq. rod (1) When Sprayed	Bindweed plants per sq. rod (1) Surviving October, 1947
1	1	1	6/16 & 10/1	757	11
2	1	5	6/16	757	7
3	3	4	7/16	165	16
4	4	3	7/26	252	15
5	5	1	9/5	-	3
6	10	-	none	-	29

(1) A uniform stand of bindweed averaging 757 plants per square rod was present on the area at the beginning of the experiment.

THE EFFECT OF SHOOT CUTTING OF FIELD BINDWEED AT DIFFERENT INTERVALS AFTER SPRAYING WITH 2,4-D UPON THE EFFECTIVENESS OF THE SPRAY TREATMENTS

F. L. Timmons (1)

An area uniformly infested with bindweed was sprayed June 16, 1947, with the butyl ester of 2,4-D at 1.3 pounds of 2,4-D

(1) Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A., cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station.

per acre. The sprayed plants on duplicate plots were undercut at a depth of four inches 1, 4, 9, 14 and 21 days, respectively, following the spray treatment. The sprayed plants showed only slight visible effects of 2,4-D one day after spraying and all leaves and stems were still alive although showing typical effects of 2,4-D nine days after spraying. All top growth was dead twenty-one (21) days after spraying. Plant counts made August 22 showed a regrowth of twenty percent of the bindweed on the plots cultivated one day after spraying, nine percent on plots cultivated four days after spraying and only 1 to 1.5 percent on plots cultivated 9, 14 or 21 days after spraying or not undercut at all. The results indicated that the effect of 2,4-D was transmitted to the roots of bindweed so rapidly that some retardation of regrowth had taken place in one day and the maximum translocation had occurred within nine days.

THE EFFECTIVENESS OF DIFFERENT COMBINATIONS OF INTENSIVE CULTIVATION AND GROWING COMPETITIVE CROPS WITH 2,4-D TREATMENT IN ERADICATING FIELD BINDWEED

F. L. Timmons (1)

Experiments started in 1946 and 1947 compare twelve different methods of using one or two 2,4-D treatments of bindweed each year in combination with intensive clean cultivation and growing competitive crops of wheat, barley, milo, close drilled sorgo, Sudan grass or buffalo grass. All treatments are duplicated and a part of each plot is not sprayed, but otherwise handled as the sprayed part of the plot. In most of the methods the sprayed and unsprayed parts of each plot are cultivated intensively between crops as necessary to prevent recovery of bindweed regrowth except when the bindweed is sprayed.

Preliminary results indicate that several of the combination methods are more effective in controlling and eradicating bindweed than is repeated spraying with 2,4-D. Complete eradication of bindweed was accomplished in two years with some of the methods. Bindweed regrowth from 2,4-D treatment appears to require as much or more intensive cultivation to complete eradication than unsprayed bindweed. In all cases where bindweed was sprayed in the growing crop the yields were considerably lower on the sprayed part than on the unsprayed part of the plot. Where the bindweed was sprayed before the crop was planted yields usually were higher on the sprayed part. Best results to date have been obtained from spraying with 2,4-D in the fall and seeding a small grain or sorghum crop in the spring. Spraying in spring followed by late seeded sorghum crops also appears promising.

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(1) Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A., cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station.

2,4-D IN COMJUNCTION WITH COMPETITIVE CROPS

A. C. Carder, Beaverlodge, Alta.

This investigation was undertaken on hoary cress (Lepidium Draba). Commenced in 1946, it included the seeding of turf-forming grasses such as creeping red fescue, Kentucky blue, timothy, and crested wheatgrass in conjunction with two treatments per season of a 2,4-D ester at .2 percent solution.

The immediate effect of the early-season chemical was a fossilated condition of the hoary cress. No root injury was noticed, however, and resprouts were evident by late summer. Autumn retreatments were given. The infestations in 1947 showed sign of severe weakening while the various grasses closed in and firmly established themselves. There was no evidence of cress in the late autumn of the second season but reoccurrence of growth is to be watched for in 1948.

Type of grass employed is not important providing it is adaptable to the soil conditions wherein the weed infestation exists.

From The Canada Dept. of Agriculture.

2,4-D ON SEEDLING WEEDS IN GROWING GRAINS

A. C. Carder, Beaverlodge, Alta.

Several trials, including plot treatment and field application by powered units, comprised this investigation. A number of weed species were studied: stinkweed (Thalaspi arvense), wild mustard (Brassica arvensis), ball mustard, shepherd's purse, peppergrass (Lepidium apetalum), lamb's quarters, wild buckwheat (Polygonum convolvulus), and blue bur (Lappula echinata).

When applications were conducted at the most susceptible stage of weed growth (several true leaves to first sign of budding) and under favorable weather conditions kills of stinkweed and the mustards with an .05 percent ester or a .10 percent sodium or amine salt ran from 85 to 90 percent and occasionally higher. Shepherd's purse proved more resistant and required a .10 percent ester or a .15 percent salt to be effectively controlled. Observations indicate lamb's quarters, blue bur, and wild buckwheat to be even more tolerant, in the order named.

The ester formulations produced a more rapid and pronounced effect than the salts when used at the same concentrations. In one instance malformation of wheat heads was noted, induced by as low as an .05 percent ester when applied on a 6-inch stand of grain. It was not determined if the yield was affected. This condition was found to be extremely rare with 2,4-D salts at .10 percent concentration.

From The Canada Dept. of Agriculture.

2,4-D ON ANNUAL AND WINTER ANNUAL WEEDS IN YOUNG GRASS STANDS

A. C. Carder, Beaverlodge, Alta.

It is frequently a problem to combat annual and winter annual weeds in newly-established meadow stands.

Several trials were made on fields of Creeping red fescue badly infested with stinkweed (Thalaspi arvense), pepper grass (Lepidium apetalum), both as annuals and winter annuals, and with the wild and ball mustards. The use of an ester at .15 percent concentration gave very effective control with no apparent repressive effects on the grass. Early treatment to catch the winter annuals in the rosette or early bud stage is essential.

From The Canada Dept. of Agriculture.

2,4-D ON BROAD-LEAVED LAWN WEEDS

A. C. Carder, Beaverlodge, Alta.

Dandelion is the chief offender in this case. Very disappointing results were had with this weed. It would seem that once a dandelion plant has put in a winter and has become well established it has considerable tolerancy towards 2,4-D. Only with concentrations of from .15 to .20 percent and use of an ester did the older plants die out and then not in any case more than 30 percent.

In 1947 an autumn retreatment was applied in addition to the spring application. To date, this dual treatment offers hope of the eradication of this pest. Killing varied from 60 to 70 percent and the surviving plants were in a very weakened condition and may well succumb to the winter.

From The Canada Dept. of Agriculture.

COMPARISON OF WEED SPRAY NOZZLES WITH 2,4-D

A. C. Carder, Beaverlodge, Alta.

Three weed spray nozzle types were tested and results are tabulated below. A fallow field carpeted with a seedling weed growth was utilized. The weeds were in the rosette to rapid growth before bud stage. Weather was favorable for treatment; bright, very light wind, temperature 70°.

The field surface tended to be rough, and this combined with the improvised spray unit employed discredited somewhat the effectiveness of the higher tractor speed.

The spray was an ester type applied at .1 percent concentration. The concentration was not altered for change in rate of application or for tractor speed.

From The Canada Dept. of Agriculture.

WEED SPRAY NOZZLE COMPARISON. BEAVERLODGE, 1947

Type of Nozzle	Pressure	Nozzle Spacing on boom	Tractor speed	Gallons per acre	Seedling weeds* killed	Comments
	lb/in.		m/hr.		%	
Hardie 526B No. 2 disc. .031	50	12"	2	35	95	Surviving weeds very unthrifty and will not produce viable seed. They consist principally of wild buckwheat, blue bur and lamb's quarters.
			4	17	85	
Spray-System .029 fan	50	12"	2	14	90	Coverage by this spray very even. Some of the more resistant weeds survived but in no condition to produce viable seed.
			4	7	80	
Spray-System .027 Hollow Cone (Atomizing)	50	12"	2	5	75	Coverage not complete. Some of the susceptible weeds survived but will not produce seed while some of the more resistant species carried on to produce seed.
			4	2.5	60	

*Consisting of:

Stinkweed	100
Ball mustard	95
Shepherd's purse	85
Lamb's quarters	65
Wild buckwheat (Polygonum convolvulus)	30
Blue bur	40

Comparative susceptibility under the conditions of this experiment.

2,4-D APPLICATION TO PERSISTENT PERENNIAL WEEDS

A. C. Carder, Beaverlodge, Alta.

In 1947 a number of trials were laid down to investigate the effectiveness of 2,4-D in eradicating several of the more noxius weeds of this region. The ester formulation at .2 percent concentration was emphasized though other types and concentrations were studied. The experiments were conducted on hoary cress (Lepidium Draba), Canada thistle, and toadflax. Treatment consisted of spring and autumn applications.

There is every indication that the complete eradication of these weeds is more than a one-season undertaking and little can be reported at this stage. A competitive crop may be a necessary adjunct.

Following two treatments of a .2 percent ester a well established infestation of Canada thistle still developed occasional resprouts. To date, Canada thistle would appear to have under 2,4-D treatment about the same degree of persistency as hoary cress. Toadflax indicates considerable tolerance to 2,4-D and it is doubtful if it can be eradicated by this chemical.

From The Canada Dept. of Agriculture.

THE EFFECT OF DOSAGE AND STAGE OF GROWTH IN THE CONTROL OF ANNUAL AND WINTER ANNUAL WEEDS

H. A. Fre[i]sen, Asst. in Field Husbandry.

Three dosages, viz; 4, 8 and 16 ounces per acre were applied at four stages of growth of spring wheat. Three formulations of 2,4-D were used.

Treatments made two days previous to emergence of the grain were effective in destroying the few seedlings of Stinkweed and Russian thistle already emerged but had no effect on the ungerminated weed seeds in the soil. Consequently, weed growth was equally dense on treated and untreated plots.

Treatments at the three leaf, the shot blade and flowering stages of the crop were quite effective against Stinkweed and Lambs Quarters. The most effective control of Russian Thistle resulted from the use of the butyl ester at the early shot blade stage of the crop before the thistle had branched extensively. The butyl ester tended to be twice as effective in the control of Russian thistle, at all stages of growth, than was the amine or sodium salt type.

Wild Buckwheat was stunted but not killed by any of the formulations or dosages at any stage of growth.

Contributor--Dominion Experimental Station, Scott, Sask.

PRE-EMERGENCE CONTROL OF WEEDS IN CORN WITH 2,4-D

P. J. Olson,
Saul Zalik
Division of Plant Science,
The University of Manitoba.

Abstract

A mixture of weed seeds consisting of lamb's quarters, wild mustard, stinkweed, wild buckwheat, hare's ear mustard, green foxtail, pigweed, Russian pigweed, ball mustard, Russian thistle and stickseed was broadcast on each of the plots including the checks on May 22nd. Corn was planted on each of these plots on May 23rd. The ester (butyl) form of 2,4-D was applied June 2nd at 2 rates; 2 lbs. and 4 lbs. per acre (pure acid equivalent).

There was practically complete control of all weeds except Russian thistle (which grew normally) on the treated plots. There was vigorous growth of all the weeds on the check plots. Neither of the rates caused any visible damage to the corn. Since the weed growth on the untreated plots was so profuse as to almost completely overgrow the corn, very low yields of dry matter were produced there, (practically no ears were produced). The treated plots yielded approximately three times as much total dry matter as the check plots.

A co-operator applied pre-emergence sprays to heavily weed infested land, planted two days previously to field corn. As ester (butyl) was applied at two rates, namely, 1¼ and 2½ pounds acid per acre. Excellent control was achieved of all susceptible annual weeds; field bindweed and perennial sow thistle, which emerged rather later, were apparently undamaged. Even at 1¼ pounds application a few corn plants were found with typical 2,4-D symptoms.

PRE-EMERGENCE CONTROL OF WEEDS IN CORN WITH 2,4-D

	Average yield dry matter in lbs. per acre.
Check	1500
2 lbs.	5554
4 lbs.	4065

Report of the Subcommittee on Research

Concerning the Eradication of Woody Plants

1947

This report is a collection of abstracts and reports of susceptibility of woody plants to 2,4-dichlorophenoxyacetic acid and its various formulations, contributed by research workers in the United States and Canada.

The subcommittee wishes to express its appreciation to those workers whose contributions made this report possible, and to the E. I. duPont deNemours & Co., of Wilmington, Delaware, for furnishing the mimeographed copies.

Woody plants

Personnel of Subcommittee:
Keith Barrons
R. S. Dunham
A. H. Larson
L. M. Stahler
L. W. Melander, Chairman

FOREWORD

Noxious woody plants present a formidable problem in the United States. Millions of dollars are spent each year to eradicate woody plants on right-of-ways along highways, railroads, drainage ditches, and power lines. The livestock industry is forced to invest vast amounts of money for feed supplements because woody plants in many old permanent pastures reduce the amount of potential forage. Federal, State, and local agencies, and individuals utilize considerable labor and chemicals to eradicate woody alternate hosts of destructive plant diseases such as stem rust of grains, blister rust of white pine, and cedar rust of apples.

Up to recently, most of the clearing work along right-of-ways has been accomplished by using manual labor and some machines, which has made the cost almost prohibitive. It is encouraging to note that the attention now given to the efficacy of herbicides is causing more and more interest in improving and lowering the cost of eradicating woody plants. Obviously, a tremendous amount of research, both basic and empirical, is necessary before the desired efficiency can be obtained.

Progress is being made, but it is greatly limited by the lack of adequate support. Considerable credit is due State and Federal experiment workers for the work they are doing on woody shrubs. The results contained in the abstracts in this report demonstrate that these investigators are making progress in spite of the limited time and facilities available to them.

From the data available in this report, a few conclusions may be drawn.

Control of woody plants by various mechanical means.

In Oklahoma and other States, various types of machines have been built and used for eradicating woody plants on the range pastures. The following quotation from an abstract by Mr. D. A. Savage, of the U. S. Department of Agriculture and stationed at Woodward, Oklahoma, is significant: "Sagebrush was controlled to best advantage by mowing it in June for two successive years and keeping livestock off the range from June to fall of those years. These treatments eradicated many of the sagebrush plants.....The advantages in cattle gains the first two winters following the summers of mowing and grazing deferment were sufficient to defray the costs of the treatments....." This lends encouragement for future investigations in controlling woody plants through mechanical means.

Efficiency of herbicides for killing woody plants.

The three types of herbicides which are receiving the most attention by investigators studying methods to control woody plants are: 2,4-dichlorophenoxyacetic acids combined with other chemicals to form salts and esters; other similar types of hormones such as 2,4,5-trichlorophenoxyacetic acid; and ammonium sulfamate. The preponderence of reports of investigations deals with the first of the above types of chemical. From the abstracts, you will note that most of the research was of the field experimental type and that there is a paucity of abstracts reporting results of basic research which obviously is needed to guide field experimentation. At the present time, the latter is hampered by lack of basic information concerning what actually happens when the various herbicides are applied to the plants in different dosages and under different conditions.

The data contained in the abstracts and the "susceptibility" table further confirm the fact that 2,4-D formulations are highly selective in their herbicidal effects. Therefore, when a complete kill is necessary, only susceptible species and varieties of plants should be recommended for treatment with 2,4-D by the general public. If only defoliation is desired, more extensive use of the chemical can be made.

In some instances where foliage sprays are ineffective, cutting the canes and trunks and applying the chemical to the cut surfaces of the stumps seem to give an effective kill. The reduction of the amount of surface to which the chemical can be applied probably necessitates the use of much higher concentration of the chemical. Some results have indicated that upward of 5 per cent solutions must be used. However, there are not sufficient data available to support a definite recommendation for the general use of this technique.

Cutting the bark and exposing the cambium so it can be treated furnish an avenue of entrance for herbicides, but the results reported are not consistent. Therefore, before any recommendations can be made, much more study must be given this method of chemical application.

The fact that 2,4,5-trichlorophenoxyacetic acid appears to kill some types of plants that are resistant to 2,4-D formulations lends hope that eventually there will be effective herbicides for every type of plant. It is hoped that further tests with 2,4,5-T will be reported at the 1948 conference.

Ammonium sulfamate has distinct herbicidal properties for killing some woody plants. Compared to 2,4-D, when used as a foliage spray, this chemical appears to be much more costly. However, when it is applied to cut surfaces of some shrub canes or to tree stumps, it appears to be very efficient in preventing sprouting as well as a good means of expediting the rotting and decomposition of the wood. The application of this chemical to the cut surfaces as a dry salt appears to be the most effective method. However, if a technique can be evolved where a highly concentrated solution may be used and an effective kill obtained, the cost of treatment will be greatly reduced. This chemical deserves considerable further study to improve its efficiency as well as to lower the cost of using it.

Combining mechanical and herbicidal methods of eradication.

Along right-of-ways of various kinds, it is necessary that the brush and trees be cleared away. These are much easier to cut off when green than when they are dead. Without subsequent treatments of the cut surfaces with effective herbicides, the regrowth develops almost immediately and sometimes it is more dense than the original growth. If an efficient application technique could be evolved and a good non-selective chemical that would kill the roots of the cut-off plants were found, a tremendous amount of regrowth would be prevented and the cost of right-of-ways maintenance would be drastically reduced. As already pointed out, some investigators have shown that 2,4-D formulations and ammonium sulfamate warrant further study for this type of use.

Progress is encouraging.

The data contained in the abstracts submitted by the various investigators show that considerable progress has been made in the chemical and mechanical phases of woody plant eradication. However, considering the magnitude of the problem, there is an obvious need for more basic research and experimentation, both with the herbicides and methods development if we are to have a sound program to recommend to the general public.

Subcommittee on eradication of woody plants.
L. W. Melander, Chairman.

ABSTRACTS

Submitted to
Subcommittee on Research
in Eradicating Woody Plants

North Central Weed Control Conference
1947

A comparison of several 2,4-D formulations when sprayed on poison ivy. Anderson, E. G. Several types of 2,4-D were sprayed on poison ivy during July and August, 1947, to compare their effectiveness when the manufacturer's recommendations, as to concentration, were followed. The plots were one square rod in area and each was sprayed with one gallon of solution by means of a knapsack sprayer. Between each operation the sprayer was rinsed first with a warm solution of sodium pyrophosphate and then with warm water. The following is the order of their effectiveness based on the percentage of observed defoliation: - butyl ester, ethyl ester, amine salt (liquid), amine salt (in carbowax) and sodium salt. This order of effectiveness was substantiated when the plots sprayed in 1946 were examined and observations made of the poison ivy killed. (Contribution of the Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa, Canada.)

Field trials using 2,4-D for control of willows. Baranek, Paul P. Field trials, using 2,4-D compounds for controlling willows, have been carried on for two years in the Sacramento-San Joaquin Delta, Sacramento. Work was conducted on the sandbar willow (Salix sessilifolia) and yellow willow (Salix lasiandra) of all sizes and ages. In some trials they were cut to ground level in the pre-treatment stage. Regrowth was sprayed at a later date. Compounds used were sodium salt and a methyl ester of 2,4-D. With the sodium salt, 3 gallons of diesel oil per 100 gallons of water were always used. The concentration in all trials was approximately 2000 ppm. Pressures used varied from 75 to 500 pounds per square inch. Rate of application was 300 gallons per acre. The results are as follows: (1) Young willows (under 3 years) required up to two applications for a complete kill; (2) older willows (over 3 years) required three or more applications; in some cases, the control period extended into the second year; (3) not much difference was noted in the control of willows that were cut in comparison to those uncut, although it was easier to get coverage on the regrowth of the cut willows using low pressures (75 to 150 pounds) than on the uncut ones; (4) no difference in results was obtained from using pressures of 75 pounds to 500 pounds. In general, better coverage was obtained on tall willows (over 15 feet high) using the higher pressure. (5) Results were the same, using either the sodium salt (with diesel) or methyl ester. (Contribution of Bureau of Reclamation, Region II, Delta District, Sacramento, California.)

A test of several solvents for the application of growth substance herbicides to bark and cut surfaces. Barrons, Keith C. and L. L. Coulter. The treatment of stumps and other cut surfaces with the growth-substance herbicides shows considerable promise as a means of eradicating woody plants. Treatment of uncut bark of young growth also has possibilities. For such applications petroleum oils have been used as solvents or carriers for the esters of 2,4-D. Presumably the oil aids in the penetration of the herbicides. The writers have used petroleum fractions and other organic chemicals as solvents for the esters of 2,4-D in comparative tests on elm stumps and uncut brush in order to determine whether differences exist in their usefulness as carriers. Stoddard Solvent, the lowest boiling petroleum fraction used, gave significantly poorer results than kerosene, No. 1 fuel oil or No. 3 fuel oil. Presumably the Stoddard Solvent tended to evaporate before an appreciable amount had penetrated to the growing tissues,

thus leaving the ester of 2,4-D near the surface. These three cheap petroleum fractions gave as good if not better results than several more expensive organic solvents. Kerosene, the various fuel oils, and similar high boiling fractions are suggested as suitable carriers for the esters of the growth substance herbicides. (Contribution of the Dow Chemical Company, Midland, Michigan.)

Possibilities of controlling brush by dormant season applications of growth-substance herbicides. Barrons, Keith C. and L. L. Coulter. Applications of the isopropyl ester of 2,4-D at a concentration of 4000 ppm in fuel oil to the uncut bark of several species of vines and woody brush during the dormant season resulted in a good kill of top growth in many instances. Tests were insufficient to accurately evaluate root kill compared with other methods of application. Treatments were made by thoroughly spraying the bark from the ground to the 2-3 foot level using a knapsack sprayer. Applications to elm of various sizes indicated that a kill cannot be expected after mature corky bark has developed. The possible value of a dormant season treatment can well be appreciated when one considers the widespread occurrence of brush in pastures, fence rows, ditches, and elsewhere on the average farm where frequently too little time is available for control measures during the growing season. Much experimental work will be required before dormant season applications of the growth regulating substances in oil to the uncut bark of woody plants can be recommended. In making tests the factors of species response to different chemicals, maturity of wood, season of application and volume and concentration requirements should be taken into consideration. (Contribution of the Dow Chemical Company, Midland, Michigan.)

The specific effect of 2,4,5-trichlorophenoxyacetic acid on members of the genus Rubus and certain other 2,4-D resistant species. Barrons, Keith C. and L. L. Coulter. The members of the genus Rubus commonly called the brambles, i.e. the raspberries, blackberries and dewberries, have been found to be highly resistant to 2,4-D. The widespread occurrence of these species as an undesirable component of pasture, orchard, and right-of-way vegetation led the writers to undertake a search for a more effective chemical of the growth substance type. The isopropyl ester of 2,4,5-trichlorophenoxyacetic acid proved very effective on the four members of this genus with which tests were conducted. Mixtures of this chemical with the isopropyl ester of 2,4-D applied to mixed woody vegetation gave good control of many species including those of the genus Rubus. Herbaceous species which have been found to be susceptible to this chemical while quite resistant to the various formulations of 2,4-D are strawberry, ground cherry and the common potato. Apparent although less conclusive differences in favor of 2,4,5-trichlorophenoxyacetic acid were noted in the case of one species of rose, two hawthorns, and osage orange. This chemical should be widely tested in 1948 on species that are resistant or partially resistant to 2,4-D. (Contribution of the Dow Chemical Company, Midland, Michigan.)

Treatment of willows with 2,4-D. Bower, Walter. Definite results were obtained on willows with 2,4-D on the Klamath Project during 1947. The following examples of treatment are representative of those made on this project:

a. On August 7, 1947, applied Dow Esteron 44 on 30 square rods of willows on the F-1 lateral. Mixture 2 lbs. material containing .8 lb. parent acid to 100 gallons of water, applied at the rate of 1.2 gallons per square rod. Willows 5 to 10 feet high. Inspection on October 23, 1947, indicates a 100 per cent kill of current season growth.

b. On August 11, 1947, applied Dow Esteron 44 on 125 square rods of willows on the C-5 lateral. Mixture 2 lbs. material containing .8 lb. parent acid to 100 gallons of water, applied at the rate of 1.6 gallons per square rod. Willows 2 to 10 feet high. Inspection of October 23, 1947, indicates approximately a 95 per cent kill of current season growth with a few live sprouts showing up.

c. On May 15, 1947, applied Chipmans 60% 2,4-D (powder form) on 70 square rods of willows on the "B" canal. Mixture 2 lbs. material containing 1.2 lbs. parent acid to 100 gallons of water applied at the rate of 1.4 gallons per square rod. Willows 5 to 15 feet high. Inspection on October 23, 1947, indicates approximately a 90 per cent kill of current season growth with several new sprouts in evidence. (Contribution of U. S. Bureau of Reclamation, Region II, Klamath District, Klamath Falls, Oregon.)

Killing arroyo Willows with herbicides. Bruns, V. F. Arroyo willows (Salix lasiolepis) growing on the shoulders of an oil-surfaced road adjacent to a small irrigation ditch near Prosser, Wash., were treated with the butyl ester of 2,4-D (2,4-Dichlorophenoxyacetic acid) on July 1, 1947, when the trees were growing actively and averaged 6 feet in height. The rates of application were 2/3, 1-1/4, 2, and 2-2/3 pounds per acre (acid basis). Two weeks after treatment all leaf growth was dead, even on plots receiving the lightest application. Eight weeks following treatment most of the original above-ground stems and branches were dead, but considerable regrowth had occurred from underground portions as well as from portions of the more mature stems as high as 18 inches above ground. Also, new shoots had emerged in abundance through the oil mat of the roadway for a distance of two to three feet from the road-shoulder and the original willow top-growth. Percentage survival and/or regrowth, as compared with untreated growth, averaged 27.5, 12.5, 3.5, and 3.5 for the 2/3, 1-1/4, 2, and 2-2/3 pounds per acre treatments, respectively. (Contribution of the U. S. Department of Agriculture, Bureau of Plant Industry, Soils, and Agricultural Engineering, Division of Cereal Crops and Diseases, cooperating with the Irrigation Branch Experiment Station, Prosser, Washington.)

Killing European barberry (Berberis vulgaris) with ammonium sulfamate applied as a dry salt to the cut surfaces of canes. Busdicker, H. B., G. W. Eade, and L. W. Melander. Ammonium sulfamate applied to cut surfaces of the canes at the ground level December 5, 1944, killed 467 B. vulgaris bushes near Spokane, Washington. An average rate of .32 pounds of the amate per bush was used. To protect the chemical from the elements, the crowns of the bushes were covered with soil. Subsequently, numerous bushes in the States of Washington, Minnesota, Wisconsin, Illinois, Pennsylvania, and Ohio have been treated at all seasons of the year with highly satisfactory results. This method of eradicating B. vulgaris is now a recommended practice for treating escape bushes. In 1942, ammonium sulfamate applied both as a foliage spray and as a crown drench to B. vulgaris bushes in Pennsylvalia did not give satisfactory results. (Contribution of Div. of Plt. Dis. Cont., Bur. of Ent. & Plt. Quar., USDA; and Div. of Hort., Wash. State Dept. of Agr.)

The use of dinitro phenol for the control of aspen. Day, Maurice W. Aspen is a problem species on millions of acres of lighter soils in the Lake States. In the past the three principal methods of controlling aspen have been cutting, girdling and poisoning with sodium arsenite. Each method has disadvantages and it appears that spraying the trunks with an oil solution of dinitro ortho secondary butyl phenol may offer several advantages. Tests at the Dunbar Forest Experiment Station over a period of three years have shown that the method gives consistent results. A solution supplied by the Dow Chemical Co. under the code number G414 when used at a concentration of .05 pounds of the toxicant per gallon of kerosene or fuel oil gave the best results. Stems up to 3 inches in diameter were completely killed in practically all cases. Larger stems were more resistant and trees over 6 inches in diameter were seldom killed. Sprouts or root suckers did not appear. Tests this year with other solutions at lower concentrations and in water instead of oil did not give satisfactory results. (Abstract of article to appear in Nov. issue Mich. Agr. Expt. Sta. Quarterly Bulletin.) (Contribution of Michigan State College-Forest Experiment Station.)

The control of certain shrubs in the Lake States. Day, Maurice W. A study of the control of hazel (Corylus cornuta), chokecherry (Prunus virginiana), pin cherry (Prunus pennsylvanica), mountain maple (Acer spicatum), alder (Alnus incana), and willow (Salix sp). Chemical, mechanical and silvicultural control are considered. Experiments indicated ammonium sulphamate was most effective on hazel, but other species sprouted strongly following treatment. Sodium arsenite was effective but difficult to apply and excessively dangerous. Sprays containing 2,4-D were most effective on hazel and least on mountain maple. Oil solutions were superior to aqueous solutions. 2,4-D was most effective in preventing sprouting and was the most promising substance tried for all species except mountain maple. Of the mechanical methods the use of heavy tractors and discs gave the most promise. Silvicultural control was based on the maintenance of fully stocked stands reproduced before reaching overmaturity. (Contribution of Michigan State College-Forest Experiment Station.)

Ammate for the control of oak brush. 1/Elwell, Harry M. 2/Ammate spray (one pound per gallon of water) applied during the rapid growing period has given good defoliation of scrubby oaks commonly found in cross-timbered areas of Oklahoma. Best results were obtained when the solution was applied at a pressure under 100 pounds and by thoroughly saturating the leaf surface. Some of the plants produced new rosettes of leaves along the main branches and stems in three to six weeks after the initial treatment. A second and sometimes a third application was necessary to completely eradicate the regrowth. The Ammate solution also burned the native grasses often found intermingled in the brush. However, areas that were sprayed three years ago are now producing a good-to-excellent stand of bluestem, switch and Indian grass. There is only a trace of sprout growth left at the present time where once over twenty thousand brushy plants per acre occupied the land. (1/Cooperative contribution for the Oklahoma Agricultural Experiment Station and Soil Conservation Research. Abstract taken from Preliminary Report of Chemicals for Brush Control, Oklahoma Agricultural Experiment Station Mimeographed Circular M-164. 2/Soil Conservationist, Red Plains Conservation Experiment Station, Guthrie, Oklahoma.)

Brush Control with 2,4-D. 1/Elwell, Harry M. 2/Tests with 2,4-D were conducted at the Red Plains Conservation Experiment Station in 1945, 46, and 47, and in field trial studies in Comanche, Pottawatomie, Johnston, Adair, and Rogers Counties soil conservation districts. For complete removal of the leaves and foliage, they must be uniformly covered with the spray solution. A rather coarse mist, at 100 to 150 pounds pressure, applied at 2,000 P.P.M. during the rapid growing period gave best results. The 2,4-D sprays are more readily effective on brush or trees from 3 to 4 feet high. There were seventeen species of brush and trees in the areas treated. Plants 80 to 95 percent affected by one application of 2,4-D were sumac, sand plum, black and honey locust, persimmon and sassafras. Those 50 to 75 percent affected were black-jack, post and dwarf chinquapin oaks, also willow. But American and winged elms, mesquite, hackberry, hickory, bois d-arc and red cedar were not affected by 2,4-D sprays in the 1946-47 tests. The 2,4-D did not affect the native grasses in any of the tests. But this material is toxic to legumes, cotton, vegetables, and many other plants. Therefore, extreme caution should be used when applying it near such plants. (1/Cooperative contribution for the Oklahoma Agricultural Experiment Station and Soil Conservation Research. Abstract taken from Preliminary Report of Chemicals for Brush Control, Oklahoma Agricultural Experiment Station Mimeographed Circular M-164. 2/Soil Conservationist, Red Plains Conservation Experiment Station, Guthrie, Oklahoma.)

Willow control with 2,4-D. Erickson, Lambert C. Trial plots to determine the value of 2,4-D for the control of willows were started in the fall of 1945 on the Black Canyon Reclamation Project, Notis, Idaho. Similar duplicate treatments were made again in the spring, summer, and fall of 1946. Materials used were: sodium salt, triethylamine salt, and acid-carbowax 2,4-D. Treatment rates were equivalent to: 0.5, 1.0, 2.0, and 4.0 pounds of 2,4-D acid per acre. The amount of regrowth of willows recurring on these plots as a result of one treatment were made on or about June 1, 1946 and 1947, on the 1945 and 1946 treatments, respectively. Regrowth recurring as an average for all these materials as compared with the original stand was 47%, 29%, 18% and 9% for the 0.5, 1.0, 2.0, and 4.0 pound rates per acre respectively. Summer and fall treatments, in general, gave more efficient results than early spring treatments. Two pounds per acre was deemed the most efficient rate. Using these results as a basis for control work, this Reclamation Project treated 43 miles of irrigation ditch banks in 1946, and 69 miles in 1947, all at the equivalent of 2 pounds of the parent acid per acre. (Contribution of the Idaho Agricultural Experiment Station, Moscow, Idaho.)

Present Information on the Mesquite Problem. Fisher, C. E., Agronomist, Substation No. 7, Spur, Texas. Progress Report 1056. Texas Agricultural Experiment Station. February 13, 1947. The fundamental principle in mesquite eradication is to kill the dormant sprout buds on the underground stem. Fire, frost, browsing or other means that kill only the topwood bring about sprouting from the underground stem and growth that is more objectionable than original trees. Methods of eradicating mesquite include oils, sodium arsenite, hand and power grubbing, tree saw and sprout control. Growth habit, stands, soil texture and moisture content and size of unit are factors that determine the effectiveness and cost of method selected. Control of seedlings, effect of shade on yield and quality of summer grasses, grazing trials on cleared and uncleared pastures and methods of preparing sodium arsenite solutions are also discussed.

Factors Affecting Action of Oils and Water Soluble Chemicals in Mesquite Eradication. Fisher, C. E., Jess L. Fultz and Henry Hopp.* Ecological Monographs 16: 109-126, April 1946. Morphological studies showed that dormant buds on the underground stem of mesquite, a sprouting shrub, must be destroyed either chemically or mechanically to kill the plant. Sodium arsenite, a systemic poison, was the most effective and economical chemical tested when application was made to sapwood of stumps. Other systemic chemicals tested were sodium arsenite, sodium chlorate, ammonium thio-cyanate, ammonium sulfamate, sulfamic acid and zinc chloride. Sodium arsenite introduced into the sapwood moved through the vascular system longitudinally with little or no tangential movement. Extent of penetration of sodium arsenite in plant tissue was directly related to length of time it remained in moist contact with sapwood. Oils such as kerosene, diesel fuels and other similar petroleum products were effective when placed in direct physical contact with dormant sprout buds on the underground stem. The volume of oils necessary to kill mesquite was influenced by growth forms, method of application and soil factors of texture and moisture. *(Agronomist, Associate Agronomist and Soil Conservationist respectively of the Texas Agricultural Experiment Station; the Amarillo Conservation Experiment Station, Soil Conservation Service, Amarillo, Texas; and the Erosion Control Practices Division, Soil Conservation Service, Beltsville, Maryland.)

Effect of foliage sprays on 2,4-D on woody plants when applied to nearby herbaceous plants. Friesen, H. A. Experiments were conducted with the object of determining whether weeds growing under shrubbery such as honeysuckle, lilac and carrigana could be eradicated by means of 2,4-D without injury to the shrubs. The sodium salt and ester types of 2,4-D were sprayed on and around the bases of the above shrubs at concentration of eight and sixteen ounces per acre. Lilac leaves and suckers which come in actual contact with the spray were halted in

their growth. The leaves were much thickened and deformed but did not wither and die until early fall. Carrigana shrubs showed a similar reaction except that the leaves dropped off much sooner, in midsummer. The untouched portions of the shrubs appeared to show no ill effect. The honeysuckle bushes treated were tall and had no suckers. Consequently, the foliage was not touched. Until the time of writing these bushes have shown no ill effects either from the 2,4-D spray, which struck the bark at the base, or from the volatile 2,4-D in the air. (Contribution of Dominion Experimental Station, Scott, Sask.)

Effect of 2,4-D on Western snowberry. Friesen, H. A. Western snowberry was treated with eight, sixteen and thirty-two ounces of the butyl ester type of 2,4-D. Two treatments were made, one in May and one in July. The two heavy rates caused considerable defoliation in the May treatment but little effect was observed after the July treatment. (Contribution of Dominion Experimental Station, Scott, Sask.)

Killing of woody plants with herbicides. Garmhausen, W. J. Herbicides used by the Ohio Department of Highways for the control of woody plants growing in the ditches within our Right of Way has been very limited. The one section that was treated with a 2,4-D ester was sprayed in midsummer and the type of growth was Maple, Elm, Poplar and Hackberry. These plants were given a thorough application and the results were very good in that within a period of two months the plants were dead and no regrowth had occurred. What the results will be in this area within a year we can only guess. However, we will have no regrowth from the sprayed plants as a few species examined showed the roots to be disintegrating. It would seem therefore that any recurrence of growth in these ditch areas will only result from seed germination. In this event these seedlings will be easily eliminated by an application early in the spring. (Contribution of Ohio Department of Highways, Roadside Improvement, Columbus 15, Ohio.)

Killing of woody plants with herbicides. Garmhausen, W. J. The use of a herbicide for the control of woody plants within our highway Right of Way is still only an experiment with the Ohio Department of Highways. We have treated sections where sight distance was limited and the trees had grown to a height where only the elimination of the lower branches was necessary. In one section the following species of trees were treated with a 2,4-D ester in late June. They were Willow, Poplar, Sycamore and Honey Locust. The lower branches were sprayed up to a height of ten feet above the ground and the results on the Willows, Poplars, and Sycamores were that the leaves died within a period of a month and the branches within a few months. There was no resprouting on the Poplar and Sycamore by late summer but the Honey Locust showed no effects whatsoever at any time. In another section where the objective again was to increase the sight distance most of the material was low growing shrubs such as witch hazel, spice bush and sumac. The remainder was regrowth consisting of Elm, Sycamore and Poplar. The herbicide used was a 2,4-D ester again and the application was also made in the early summer. The results by late summer were that where the materials were thoroughly and entirely sprayed the plants were completely dead. (Contribution of Ohio Department of Highways, Roadside Improvement, Columbus 15, Ohio.)

Effect of treatments with ammonium sulfamate and sodium chlorate on stumps of cottonwood (Populus deltoides). Hanson, Noel S.[1]/ A series of cottonwood stumps ranging from 24 to 36 inches in diameter were treated with ammonium sulfamate (Ammate) on March 15, 1947, after the trees had been cut in November of 1946. Four methods of application of the ammonium sulfamate and one method with sodium chlorate were used. (1) Cambium treatment in ½-inch holes 8 inches apart and 4 inches deep. Approximately one pound per stump. (2) Same as (1) except size of holes 3/4 inch and approximately 1½ pounds per stump applied. (3) Approximately

2 pounds per stump as dry cambium treatment over top of entire cambial ring. (4) Same as (3) except that the chemical was dissolved to a concentrated solution and poured over the cambial ring. (5) No treatment. Two stumps were treated by each method. One stump was treated with sodium chlorate according to method (3). This stump was burned 10 days after treatment. Observations on October 15, 1947, showed the following: (1) One cambium sprout on each stump, two root sprouts on one, and none on the other. All sprouts 4 feet tall. (2) No cambium sprouts on either stump. Three root sprouts 5 feet tall on one and one sprout one foot tall on the other. (3) Both stumps dead. (4) No cambium sprouts, but two root sprouts 2 and 4 feet tall on each. (5) Untreated stump with two and five cambial sprouts and two and one root sprout 3 and 6 feet tall. The sodium chlorate treated stump was dead. (1/Assistant Agronomist, Nebraska Experiment Station, Lincoln, Nebraska.)

Effect of 2,4-D spray on black walnut trees. Hanson, Noel S. 1/At Lincoln, Nebraska, a row of black walnut trees was damaged by drifting 2,4-D spray applied experimentally by airplane to a field of oats. The type 2,4-D applied was butyl ester at dosages of $\frac{1}{4}$ and $\frac{1}{2}$ pounds per acre in 2 gallons diesel fuel. The trees were in full leaf and buds were present at the time. During one flight the wind velocity was approximately 5 to 8 miles per hour directly toward the trees. Glass plates laid out in the oat field intercepted 50 to 65 droplets per square inch. Glass plates placed near the walnut trees intercepted 25 droplets per square inch. No drift was intercepted near the trees during the other flights. Thirty hours after treatment leaves on the sprayed side were drooped. Twigs showed typical 2,4-D curvature. Two weeks after treatment a differential leaf coloring between trees was noticed indicating differential tolerance. A few trees showed little effect of the spray and leaves were green. Other trees had yellow leaves on one side. Some trees had yellow leaves throughout. Later observations showed that the nut crop was almost eliminated. Nuts were produced only on trees that earlier had shown the greater tolerance. Defoliation and twig damage was in proportion to the earlier leaf color effect, varying from approximately 90 per cent to less than 5 per cent defoliation. No tree was completely killed. (1/Assistant Agronomist, Nebraska Experiment Station, Lincoln, Nebraska.)

Field trials with 2,4-D for control of poison oak. Koehler, James W. Definite results were obtained in field trials in the Shasta Lake area using the butyl esters of 2,4-D mixed with diesel oil for the control of poison oak. An estimated ten acres of poison oak with an average density of 25% was sprayed with a low volume concentration of the butyl esters of 2,4-D mixed with diesel oil during the first week of July 1947. The commercial product tested was Weed-no-More 50 in a concentration of one part commercial product to twenty parts diesel oil at an average rate of application of 25 gallons per acre. Complete coverage of the foliage was attempted without causing run-off of the spray material. Material was applied with power spray equipment at a pressure of 30 pounds per square inch. The maximum temperature during spraying was 93°F with a clear sky, and a light breeze. Observations made at intervals during the months of July, August and September indicate that a good top and crown kill was obtained on about 80 percent of the plants. No regrowth had started at the time of the last observation in September. (Contribution of the Bureau of Reclamation, Region II, Sacramento Valley District, Chico, California.)

Effect of foliage sprays with various 2,4-dichlorophenoxyacetic acid formulations on native barberries (Berberis canadensis Mill. and B. fendleri Gray). Melander, L. W., E. A. Lungren, and W. M. Watson. During 1946 foliage sprays of various formulations of 2,4-dichlorophenoxyacetic acid in concentrations of 500, 1,000, 1,500, and 2,000 ppm were applied to quarter-square-rod plots of B. canadensis in West Virginia and B. fendleri in Colorado. Three applications were made: one in early summer, one in midsummer, and one in September. The 2,4-D formulations had little or no effect on B. canadensis, while B. fendleri seemed relatively susceptible to this herbicide. The ammonium and triethanolamine salts of 2,4-D killed the latter species of barberry in most cases; however, methyl ester of 2,4-D seemed to be the most consistently effective. Concentrations of 2,000 ppm were the most effective on this species of woody plants. The best "kills" were obtained from the midsummer treatments, and the fall treatments were the least effective. The midsummer applications of 2,4-D appear to be as effective as the chlorate (Atlacide) checks. These results are based on only one year's tests. A similar series was run in 1947, but the results will not be available until 1948. (Contribution of Div. of Plt. Dis. Cont., Bur. of Ent. & Plt. Quar., USDA.)

Effect of various concentrated 2,4-D formulations when applied to cut surfaces of the canes of European barberry (Berberis vulgaris). Melander, L. W. In the fall of 1945, triethanolamine salt of 2,4-dichlorophenoxyacetic acid applied as a 30 per cent solution to the cut surfaces of the canes killed five large barberry bushes (B. vulgaris) in Minnesota. Uniform lethal results with salts and esters of 2,4-D applied to cut surfaces of barberries have been obtained in the greenhouse; however, field tests with different concentrations of this chemical in several states have shown that, while a high percentage of the bushes are killed by this method, there still is some sprouting. Where sprouting occurred, there were indications that the concentration of the chemical was not sufficient or that the method of treatment was faulty. Further study is being made to improve the methods used in applying 2,4-D formulations to the cut surfaces of barberry canes and to determine the most effective concentration of the chemical. (Contribution of Div. of Plt. Dis. Cont., Bur. of Ent. & Plt. Quar., USDA.)

Killing salt cedar (Tamarix gallica) with herbicides. Mercer, William H. Definite results were obtained with 2,4-D ester, 1000 ppm, in water solution applied as spray on foliage, when growth did not exceed 1" diameter or approximately two years' growth. Older and larger growth was defoliated but the root system was not seriously affected. Best results were obtained when the spray was applied on young growth of the current season. Experimental work was done on Bureau of Reclamation Irrigation Projects at Tucumcari, New Mexico, and El Paso, Texas. (Contribution of the Bureau of Reclamation, Region 5, Amarillo, Tex.)

Killing willows (Salix sp.) with herbicides. Mercer, William H. Definite results were obtained with 2,4-D, DuPont I, N.6065, 1000 ppm, in water solution, applied as spray on foliage. Equal success was obtained on growth of current season 2' high, and on growth of previous season plus the current season's growth 4' to 6' high. This experimental work was done on canal banks of the Bureau of Reclamation Irrigation Project at El Paso, Texas, in May 1944. There has been practically no regrowth. (Contribution of the Bureau of Reclamation, Region 5, Amarillo, Texas.)

The best time of year to apply herbicides for the eradication of poison ivy. Minshall, Wm. Harold. At Ottawa, Canada, in each of the months of June, July, August, and September, 1946, one gallon of 1000 ppm solution of 2,4-D acid with carbowax and 2,4-D triethanolamine salt, calculated on the basis of weight, and one gallon of 10% ammonium sulfamate were applied, with a knapsack sprayer, to plots, 100 square feet in area, containing approximately an 85% stand of poison

ivy. The percentage reduction in poison ivy in July 1947 for the June 13, July 16, August 14, and September 12 treatments respectively were: for 2,4-D acid with carbowax 80%, 6%, 6% and 7%; for 2,4-D triethanolamine salt 78%, 6%, 6% and 6%; and for ammonium sulfamate 98%, 90%, 47% and 17%. The applications made in June, when the plants are in flower, gave by far the best control of poison ivy for all three materials. The July, August, and September treatments with 2,4-D acid and its triethanolamine salt and the September application with ammonium sulfamate had very little effect on the stand of poison ivy. In general, the results obtained from these tests made in 1946 corroborate those from the 1945 treatments in that applications in June produced the best control of poison ivy. However, variations in results were evident for the different materials and, on the basis of present information, it would appear as if the control from June applications with certain 2,4-D formulations is not as consistent as with that from ammonium sulfamate. (Contribution of the Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa, Ontario, Canada.)

The effect of cutting prior to treatment on the eradication of poison ivy with herbicides. Minshall, Wm. Harold. In an area with an approximately 80% stand of poison ivy, all top growth was removed, with a sickle, from certain plots in the month of June for three consecutive years. Other plots were not cut. In the month of July applications of 10% ammonium sulfamate and of 1000 ppm 2,4-D acid, with carbowax as cosolvent, were made to normal uncut plots, to plots cut in June of the current year, and to plots cut in June of the previous year. With the 2,4-D the best control was obtained on the plots from which all top growth was removed in the current year and the poorest control from the normal uncut plots. Those plots from which top growth was removed in the year previous to treatment were intermediate. With ammonium sulfamate removal of top growth prior to treatment gave the best control with the 1945 applications but with those made in 1946 the results were approximately the same for the normal uncut plots and those cut prior to treatment. Although the results with ammonium sulfamate have not been as consistent as with 2,4-D, in no case has the removal of top growth prior to spraying been detrimental as regards control from these July applications. The experiment is still in progress. (Contribution of the Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa, Ontario, Canada.)

A comparison of 2,4-Dichlorophenoxyacetic acid formulations with ammonium sulfamate and sodium chlorate as eradicants for poison ivy. Minshall, Wm. Harold. At Ottawa, Canada, one gallon of 500, 1000 and 2000 ppm concentration of four 2,4-D formulations, calculated on the basis of weight, were applied on June 19, 1946, to plots, 100 square feet in area, containing approximately an 85% stand of poison ivy. For comparison, applications of one pound per gallon of ammonium sulfamate and sodium chlorate were included in the experiment. The percentage reduction in poison ivy in July, 1947, for the respective applications of 1000 ppm 2,4-D and the 10% ammonium sulfamate and sodium chlorate were: 2,4-D methyl ester 98%, 2,4-D acid with carbowax 67%, 2,4-D ammonium salt 50%, 2,4-D triethanolamine salt 24%, ammonium sulfamate 98%, and sodium chlorate 88%. There was considerable variation in the effect of the different 2,4-D formulations on poison ivy. The control obtained from the methyl ester of 2,4-D was equal to that from ammonium sulfamate and better than that from sodium chlorate. Increasing the concentration of the 2,4-D formulations increased the control of poison ivy, but not on a proportional basis. The control of poison ivy obtained from these treatments made in 1946 was inferior for the 2,4-D acid, and 2,4-D ammonium salt but somewhat superior for the ammonium sulfamate and sodium chlorate to that from similar applications made on approximately the same date in 1945. The 2,4-D methyl ester was not applied in 1945. (Contribution of the Division of Botany and Plant Pathology, Science Service, Dominion Department of Agriculture, Ottawa, Ontario, Canada.)

2,4,5-trichlorophenoxyacetic acid as a weed killer. Neville, Homer B. and C. J. Willard. The butyl ester of 2,4,5-trichlorophenoxyacetic acid was compared with the butyl ester of 2,4-D in a small number of trials. Blackberry bushes, both old and new canes, were treated at 4 pounds of acid per acre. 2,4,5-T. killed all top growth while 2,4-D killed only about 50% of the top growth. Cottonwood (Populus deltoides) has been rather resistant to 2,4-D formulations but the foliage was readily killed by 2,4,5-T. Cattails in water were treated with 2,4,5-T. at the rate of 8 pounds of acid per acre. The top growth was completely killed. Cattails have been quite resistant to 2,4-D. There has not been time to determine regrowth of any of these plants but the material is worth further study. (Contribution of Ohio Agricultural Experiment Station in cooperation with the Sherwin-Williams Company.)

Chemical eradication of Ribes. Offord, H. R. Since 1929, substantial economies have been made in Ribes eradication for white pine blister rust control by using chemicals for killing Ribes on sites where eradication by pulling or grubbing has been troublesome and costly. Methods and chemicals of greatest practical import have been: (1) Spraying the foliage and stems of intact Ribes with aqueous sodium Chlorate (1 to 1.5 lbs. per gallon of water), ammonium sulfamate ($\frac{1}{2}$ to 1 lb. per gallon of water), or 2,4-dichlorophenoxyacetic acid (750 ppm). (2) Decapitating the Ribes at or close to ground level and applying liquid or solid chemical directly to the freshly scarified crown or stub ends of stems. Liquids used have been Diesel oil, saturated aqueous ammonium sulfamate, and concentrates (1 to 20%) of 2,4-D (either an ester of 2,4-D in kerosene or Diesel oil, or an aqueous amine salt). (3) Spraying or wetting the intact basal stems with a light penetrating oil (kerosene) containing from 1 to 20% by weight of an ester of 2,4-D. Method (3) has been successful on small test plots but has not yet been used on an extensive scale. (Contribution of Bureau of Entomology and Plant Quarantine, Division of Plant Disease Control, Berkeley, California).

Testing of 2,4-D compounds for killing Ribes. Offord, H. R. Field tests (1945-47), and large-scale practical use (1947) of 2,4-D compounds for Ribes eradication have shown that: (1) Of the 27 Ribes species on which tests were made, only 7 (R. americanum, R. bracteosum, R. cereum, R. nevadense, R. petiolare, R. roezli, and R. speciosum) can be effectively and economically killed by dilute sprays applied to aerial plant parts. (2) Highly susceptible Ribes are not killed by dilute sprays unless all stems and leaves are thoroughly covered. (3) Effective work even on highly susceptible species can be done only during a relatively short period of the year. For mature bushes of most Ribes species this period corresponds to the interval between the start of vegetative growth (leaves fully expanded) and the time that fruits are about two-thirds size. (4) Ease of killing plants of a susceptible species varies with age, growth rate, and vigor. Old, slow-growing plants are the hardest to kill and have a shorter period of susceptibility during any one growing season than young, fast-growing plants. (5) Titanium dioxide, a brilliant white pigment (commercial grade known as Titanox B-30) is used as a marker at the rate of 1 to $1\frac{1}{2}$ pounds per 100 gallons of 2,4-D spray solution. (6) Sodium, ammonium, and amine salts, and the several commonly available esters of 2,4-D are about equally effective on Ribes if comparisons are made on the acid equivalent basis. (7) All species of Ribes can be killed by applying concentrates of 2,4-D (1 to 20%) directly to the freshly exposed crown of decapitated plants. (Contribution of Bureau of Entomology and Plant Quarantine, Division of Plant Disease Control, Berkeley, Calif.)

Studies in mechanical treatment for control of woody plants. Savage, D. A. Ordinary heavy-duty power take-off mowers, equipped with snub-nosed guards for heavy brush or rock guards for medium-heavy brush, heavy under-serrated sections, and a complete set of hold-down clips, have been effective in cutting most local types of brush when operated in low gear the first year and in ordinary gear but

the opposite direction the second year. Discing, railing, or rolling have been less effective than the mower in cutting the surface growth of brush. Brush beaters remove the surface growth more completely than the mower but are more difficult to keep in working order. Sagebrush was controlled to best advantage by mowing it in June for two successive years and keeping livestock off the range from June to fall of those years. These treatments eradicated many of the sagebrush plants, reduced the vigor of the remaining shrubs, controlled many of the weeds, and greatly improved the vigor, density, and production of range grasses. (Contribution of the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Woodward, Oklahoma.)

Grazing results in brush control. Savage, D. A. The effect of mowing sagebrush on beef production has been studied in duplicate mowed and nonmowed pastures grazed during the growing season and on similar pastures grazed throughout the year. The advantages in cattle gains the first two winters following the summers of mowing and grazing deferment were sufficient to defray the costs of the treatments. After that the advantages were clear profit and amounted to increases of 60 to 70 percent in carrying capacity, 10 to 16 percent in gain per head, and 80 to 91 percent in gain per acre. The actual increases due to mowing ranged from 45 to 48 head of cattle in carrying capacity per section (640 acres), 29 to 47 pounds in gain per head, and 32 to 38 pounds in gain per acre, depending on whether the pastures were grazed during the growing season or on a year-long basis. (Contribution of the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Woodward, Oklahoma.)

Study of root reserves in brush. Savage, D. A. Chemical analyses conducted through the cooperation of Dr. J. E. Webster of the Oklahoma Agricultural Experiment Station revealed that sagebrush roots contain the least quantity of carbohydrates and other food constituents in June and, therefore, can be controlled most effectively by mechanical treatment at that time. The low point of food storage in the roots of other plants occurred in May for skunkbush, on April 1 and June 1 for pricklypear, and on May 15 for shinnery-oak. The root reserve studies also have an important bearing on the proper time to control shrubs by spraying with 2,4-D. All of the shrubs grow actively for a month or so before the roots reach the minimum point of carbohydrate storage. (Contribution of the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Woodward, Oklahoma.)

Use of 2,4-D in brush control. Savage, D. A. Excellent results in the control of sagebrush, skunkbush, sandplum, and many weeds were obtained in preliminary tests with various types of 2,4-D chemicals in 1946 and in extensive tests in 1947. The differential tests with various combinations of 2,4-D during the current year were conducted on 1,000 acres of range land in the Texas Panhandle and on 500 acres of land near Woodward. These studies were conducted through the cooperation of ten chemical companies, an airplane-spraying company, and local stockmen. The work was done by both air and ground-spray equipment. These and other range studies were under the immediate supervision of E. H. McIlvain of the Forage Division who is now completing graduate work at Utah State College. The treatment that seemed to be most effective in eradicating the three plants mentioned above consisted of applying 1 pound of 2,4-D acid, 0.6 pound of sodium carbonate, 1 gallon of diesel oil, and 4 gallons of water to the acre with an airplane. This home-made mixture, devised by J. R. Harlan of the Forage Division, represents the first of its kind used in brush-control work and was much cheaper and more effective than any commercial formula tested. The most effective time of control appeared to extend from about April 15 to June 1. One treatment during this period resulted in much more effective and cheaper control than was accomplished from three successive annual mowings.

Stockmen of the region are now arranging with an airplane spraying company to apply these results on an extensive scale in 1948. The spraying company agrees to furnish, mix, and apply the materials in the proportions and at the rate listed above, at a cost of $2.00 an acre. None of the chemical treatments tested to date gave satisfactory control of shinnery-oak. A home-made preparation, consisting of 1 pound of 2,4-D acid, 3 pints of automobile antifreeze (methanol base), and 13 pints diesel oil to make 2 gallons per acre, appeared to give about as good control as commercial esters costing five to ten times as much. There was a considerable difference between brands of methanol antifreeze; however, one brand caused severe crystalization on the nozzles and precipitation in the mixing tank. (Contribution of the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Woodward, Okla.)

Killing brush on cut-over land in northern Minnesota. Schantz-Hansen, T. and Raymond A. Jensen. About two acres of a brushy forest tract were sprayed in August 1946, using 2,4-D (23.3 percent triethanolamine salt) at the rate of 1¼ pounds per 100 gallons of water. The area sprayed had a dense stand of hazel, alder, raspberry, cherry and some aspen with a scattering of conifers planted in 1946. The action of the chemical was evident by late August. A check of the area in July 1947 showed almost a complete kill of hazel, though there was some sprouting from stubs made during logging. Alder was completely killed except where spraying was incomplete. Raspberry showed no effect of the herbicide. Cherry was completely killed. Aspen was not affected when it was above the general level of the brush canopy. Scattered conifers, white pine and white spruce, planted ten years previously and now from two feet to three feet in height were not affected. Whether this was because they were protected from the spray by the brush or were resistant is difficult to determine without further trials. In 1947, an additional four acres was sprayed using the same 2,4-D preparation as in 1946, and a second 2,4-D preparation (44 percent isopropyl ester of 2,4-D) at the rate of one quart per 100 gallons of water. A spray adjuvant, I.P.C. Emulsion #272, was added to the herbicides. Results of the 1947 spraying will not be apparent until 1948. (Contribution of the Cloquet Forest Experiment Station, Division of Forestry, University of Minnesota.)

Control of willows with 2,4-D. Scott, H. Clay. Definite results were obtained with the use of 2,4-D on willows (locally termed sand bar willows) in test plots on seven Bureau of Reclamation projects located in Montana, Wyoming and South Dakota. The spraying was done on a total area of about 11 acres from June to September. The following observations were made:

1. The reaction was not complete by the following spring, but seemed to carry over into the summer. Patches showing as high as 30% survival in the spring later showed only about 5%.
2. There was a wide range in rates of application from 3 (or perhaps lower) to 6 pounds per acre.
3. An application of enough liquid to wet the foliage without waste at 1,000 PPM gave equally good results as higher rates of concentration.
4. There have been no material differences noted with applications made at different stages of growth.
5. No material differences have been observed with different types of 2,4-D, i.e., sodium salts versus esters.
6. There is some indication that diesel fuel added to the mixture increases the effectiveness of 2,4-D.

Work done in the 1947 season may narrow down some of the vague points, but early reports tend to verify observations of 1946. (Contribution of Bureau of Reclamation, Region 6, Billings, Montana.)

Effect of 2,4-D on willows and cottonwood in northwestern Minnesota. Spring, E. W. 1/ We have been using the following 2,4-D:

Weedone	American Chemical Paint Co.	9.6% Ethyl ester
Weed-no-more	Sherwin-Williams	40.0 Butyl ester
Esteron 44	Dow	44.0 Isopropyl ester

Using the Dow preparation with 2600 parts of active ingredient to a million parts of diesel fuel we (apparently) had a 100% kill on small willows up to 6' in one week with one application. We had 772 cottonwood trees up to 15" in diameter which were either pulled with a tractor, dynamited or close cut. The new growth up to 7 and 8' is what we sprayed with the 2,4-D. One application checked the new growth on most of the 4 miles we worked on. A second application killed much of it and we are now waiting for the results on the third application. We found that painting the cambium was not too effective. (1/The Spring Gravel Company, Crookston, Minnesota.)

Killing alder brush with herbicides. Stoeckeler, J. H. and N. T. Samson. At the Northern Wisconsin Forest Research Center, we found spraying with Weedone, Esteron and Ammate caused a heavy foliage loss in alder, but the stems (at the end of the season in which spraying was done) still appear green and we fear they will leaf out with good vigor again in the spring of 1948. Hence our results are totally inconclusive until we make a fall 1948 count. From present indications, a good treatment is to cut all alder in May and then spray the leaves of the resulting sprouts in late July or August of the same year, or when they are several feet high, using strong concentrations of Ammate or Esteron at a strength of 3/4 of 1 percent. Such a treatment, however, will be rather expensive, probably about $21 to $30 per acre, which includes the cost of cutting, spraying and chemicals. Esteron will be somewhat cheaper than Ammate, based on our present experience. (Contribution of Lake States Forest Experiment Station, University Farm, St. Paul, Minnesota.)

Miscellaneous Reports and memoranda concerning control of willows. Thompson, Jesse R., T. L. Sundquist, H. W. Emery, Elmer Sabin, W. H. Hirst, et. al. Willows have been effectively controlled on Reclamation projects in the intermountain area by spraying them with various formulations of 2,4-D by mixing one part of 2,4-D acid equivalent to 1,000 parts of water. Increasing the dosage to one part per 500 did not show appreciable gains in effectiveness, while mixing one part of sodium salts of the acid to 1,500 parts of water proved to be comparatively ineffective. It was observed that complete coverage of the willow was necessary and that any method of application which failed to give complete coverage, such as spraying by airplane, gave poor results. It was also noted that the amount of regrowth in the form of new shoots will vary considerably, depending upon factors which have not been determined. (Contribution of the Bureau of Reclamation, Region 4, Salt Lake City, Utah.)

Effect of isopropyl ester of 2,4-D on Prunus Americana seedlings. Viehmeyer, Glenn, Horticulturist. On July 14, 1947, an exploratory experiment to determine the effect of 2,4-D on woody plants was started. Two-year-old seedlings of wild plum, 3/8 to 1½ inches caliper and growing in the nursery, were used as test plants. These trees were sawed off 1-2 inches above ground and a 40% commercial formulation of the ester was diluted to a 20% solution with gasoline and applied to the freshly-cut stumps with a brush. About 1 oz. of the solution was required to treat 100 plants. On October 1, 1947, counts were made; 8.5% of treated plants showed some regrowth. Shoots from these plants ranged from ½ to 8 in. long and showed typical 2,4-D distortion in both stem and leaf. Untreated checks had shoots 18 to 30 in. long; 91.5% of treated plants showed no regrowth; and 2,4-D effects ranged from complete prevention of shoot production to complete death of the entire root system. Results of the test indicate that the ester of 2,4-D applied to freshly-cut stumps may give a high degree of control of wild plum but that various degrees of tolerance to the chemical exist in the species. The degree of control secured may be affected by the degree of tolerance of the particular race of wild plum treated. (Contribution of the University of Nebraska Substation, North Platte, Nebraska.)

Herbicidal effect of ammonium sulfamate on Berberis canadensis Mill. Watson, W. M. and L. W. Melander. Preliminary field tests conducted in West Virginia during 1942 and 1944, followed by more extensive tests in 1946, show that ammonium sulfamate is highly toxic to B. canadensis. Treatments of 2, 3, 4, 5, and 6 pounds of amate per square rod, applied as foliage sprays in the early summer and midsummer, killed all of the growing canes. With the fall applications, dosages of 4, 5, and 6 pounds of amate were found necessary to obtain the same results. Considering the sprouts that appeared on the plots during the current year and in 1947, the early summer applications were the most effective, with midsummer next, and fall treatments the least effective. Dosages of 2 and 3 pounds of amate per square rod applied in midsummer, and 4, 5, and 6 pounds in the early fall appear to be even more toxic to the canes of B. canadensis than comparable dosages of sodium chlorate, which was used as a check in all cases against the amate treatments. More plots were treated with amate in 1947, but the results will not be available until next year. (Contribution of Div. of Plt. Dis. Cont., Bur. of Ent. & Plt. Quar., USDA.)

Effect of 2,4-D on elderberry. Willard, C. J. A clump of elderberry bushes 5 to 7 feet tall was thoroughly sprayed June 26, 1945, with the sodium salt of 2,4-D at 1500 ppm and at least 6 gallons per square rod or at least 8 pounds per acre. The top growth was all killed but there were some resprouts from the base that fall; likewise, the next spring. The clump was resprayed on June 8, 1946, at the same concentration but, of course, much less spray used. Resprouting followed in 1947. The clump was sprayed again on May 24th but it is not yet killed. Obviously, it can be if the treatments are repeated sufficiently. Experiences with elderberries in fence lines elsewhere are similar. (Contribution of Ohio Agricultural Experiment Station in cooperation with the Dow Chemical Company.)

Effect of 2,4-D on poison ivy. Willard, C. J. Between 100 and 200 plots of poison ivy have been experimentally sprayed or dusted with 2,4-D preparations at Columbus and vicinity in the course of these investigations. The ester formulations are much more active and effective than the salt formulations although 100 percent kills have been obtained with the latter under favorable conditions. Under the most favorable conditions, a concentration of 2 pounds per acre of the acid in ester form has given essentially 100 percent kills. There is bound to be some regrowth in any extensive weed-killing operation. Complete kills have been obtained at any time from when the leaves were about 1/4 expanded until late fall when autumn coloration was beginning. Fall treatments appeared to be particularly effective; likewise, summer treatments in orchards. On the other hand, there have been a considerable number of failures to kill poison ivy under a wide variety of conditions, so that we are never quite sure of the result when we apply 2,4-D to a poison ivy patch. Nevertheless, we would recommend 2,4-D esters as the most convenient and economical method of eradicating poison ivy. Ammonium sulfamate, 1 pound to the gallon of water, applied at 1 to 3 gallons per square rod, has been the surest "one-shot" treatment for poison ivy, but it is so expensive that it will not compete strongly with the ester formulations of 2,4-D. (Contribution of Ohio Agricultural Experiment Station in cooperation with the Dow Chemical Company and the Sherwin-Williams Company.)

Killing elm trees with 2,4-D. Witman, E. D. No effect was noted on 30-foot elm trees from 10 ml. of 40% butyl ester formulation of 2,4-D introduced to the cambium by means of a 3/8" pipe nipple pounded into the cambium layer. This may be accounted for by the fact that the herbicide level did not change in the pipe over a period of three weeks. (The bark in the pipe apparently functioned as an efficient cork). The test was run in August. (Contribution of the Sherwin-Williams Co., Cleveland, Ohio.)

Killing poison ivy (Rhus toxicodendron) with 2,4-D. Wood, H. E. During 1945-46, 29 plots of dense poison ivy on porous shale mostly exposed to the sun were treated in July and early August with various formulations of 2,4-D at .1 to .2 concentrations. Kills as checked to August, 1947, while ranging from nil to practically 100%, were in the main satisfactory, the esters and amine salts proving considerably better than the ammonium or sodium salts. June 12th, 1947, 3 plots on clay soil, in shade, sprayed with 1 pound acid per acre respectively, Esteron 44, Weed-No-More 40, and Hormono Ivy Kill, July 21st appeared 95% killed, but by September 9th showed 100% recovery. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

Killing snowberry (Symphorecarpus racemosus) with 2,4-D. Wood, H. E. On July 11, 1947, two one-acre plots in a pasture field sparsely infested with snowberry 16 inches in height, still succulent but past flowering, was sprayed by machine with an isopropyl ester at 1 and 2 pounds acid per acre. Except for traces of browning of leaves, treatments had no effect upon the plants. Where the occasional plant had been knapsack sprayed with a 1-to 2-pound acid concentration of ester or amine salt, in early spring when growth was tender, snowberry appeared susceptible. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

Killing white poplar (Populus tremuloides), with 2,4-D. Wood, H. E. and G. R. Fraser. On May 30th, 1947, 6 plots of regrowth poplar about 8 feet in height were sprayed at 2 pounds acid per acre, sodium salt, amine salt, and ester, and 3 plots with another ester at concentrations of 1, 2 and 4 pounds. While growth was retarded--estimated from 50% to 77%, the sodium salt the lowest, the 4-pound concentration ester the highest--the poplars were not dead above ground when a ditching machine moved over the plots in late September. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

Killing willow (chiefly Salix amygdaloides) with 2,4-D. Wood, H. E. Although no plot work was conducted, the Manitoba Drainage Maintenance Board by use of a Buffalo Turbine, sprayed during 1947, approximately 100 miles, comprising 642½ acres, of drainage and road ditches, with willows from three to twenty feet in height, the major problem. Both an ester and amine salt were used at approximately 1½ pounds acid in 5 imperial gallons water per acre. Apart from misses in coverage an excellent kill was obtained with little indication of any considerable regrowth. Several municipalities, using boom equipment, treated limited trial areas of road ditches with similar results. (Contribution of the Weeds Commission, Manitoba Department of Agriculture, Winnipeg, Canada.)

The effect of 2,4-D and other chemicals and different methods of treatment on tree sprouts. Zahnley, J. W. Tree sprouts mainly elm ranging from one-half to two inches in diameter were treated with sodium salt of 2,4-D, butyl ester of 2,4-D, ammate, and sodium chlorate (1) by hacking the stems and applying the undiluted chemical to the wound, (2) cutting the plants and spraying the stumps with a high concentration (8%) of 2,4-D butyl ester and (3) cutting the plants and spraying the regrowth. All treatments except on the regrowth were made July 9, 1947. On October 20, plants hacked through the bark on 3 or 4 sides of the trunk and treated with the ester of 2,4-D were all dead. Seventy-five percent of the tops of plants treated similarly with sodium salt were killed but all had green leaves below the tops. Plants treated with ammate by this method were not severely injured. Sixty-five percent of the tops were dead on those treated with sodium chlorate but sprouts were starting from the base. Ninety percent of the stumps that were sprayed immediately after cutting failed to produce regrowth and seem to be killed. Plants cut and treated after regrowth was well started appear to be killed. Treatment of sprouts of Osage hedge and mulberry failed to kill. (Contribution of the Department of Agronomy, Kansas Agricultural Experiment Station, Manhattan, Kansas.)

The effectiveness of different types of 2,4-D in the eradication of buckbrush and sumac. Zahnley, J. W. Duplicate treatments on buckbrush (Symphorocarpus orbiculatus) and on sumac (Rhus glabra) were made June 6, 1946, commaring five different esters, ethyl, butyl, isopropyl, amyl, and loro, and sodium salt, ammonium salt, triethanolamine, and methoxone at the rate of 2.4 pounds per acre. Final observations for the season were made November 6, 1946. Results with the different esters were similar. All were decidedly more effective on buckbrush than the other formulations. 25 to 40% of the stems were dead to the ground or within 2 inches. Some regrowth appeared from the base of the plants only. Plants treated with sodium and ammonium salts had lost most of their leaves earlier but 75% of the stems were still green almost to the top; about 15% had made some regrowth but no basal shoots. 5% were dead to near the ground. Only 5% of the plants treated with methoxone and triethanolamine salt were making regrowth; otherwise, results were similar to sodium and ammonium salts. All plots were retreated June 9, 1947, using only isopropyl and butyl esters. On October 23, 1947, variations of results from the previous year's treatments had disappeared and 95% of the plants on all plots were dead and most of the crowns were decaying. A few very weak shoots were starting from the live plants that remained. The treatments in 1946 were more effective on sumac than on buckbrush and there was no significant difference in the effect of the different formulations. Sumac seemed to be more readily killed by 2,4-D. (Contribution of the Department of Agronomy, Kansas Agricultural Experiment Station, Manhattan, Kansas.)

REACTION OF WOODY PLANTS TO 2,4-D FORMULATIONS

Composite Summary of all Data Submitted to the Subcommittee on Woody Plants

R-Resistant I-Intermediate S-Susceptible

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Alder	Alnus incana	Mich.	MWD	S		S	
		Minn.	Sch. Hans.	S			Esters & amines
Ash	Fraxinus sp.	Mich.	Grig.	R			Salts, esters acidi.
Ash, prickly	Xanthoxylum americanum	Pa.	Berg.	R	S		Esters & amines
Ash, red	Fraxinus pennsylvanica	Minn.	Kruse	R	S	S	Esters
		Ohio	CJW	R			
Aspen	P. tremuloides (See poplar)						
Azalea	Rhododendron sp.	Del.	DuPont	R			1% amm. salt
Barberry, E. native	Berberis canadensis	W.Va.	Mel.	R			Salts, esters, amines
Barberry, W. native	Berberis fendleri	Colo.	Mel.	S			Salts, amines, esters
Beech	Fagus sp.	Del.	DuPont	R			.2% amm. salt
Birch, paper	Betula papyrifera	Mich.	MWD	S			
Bittersweet	Celastrus scandens	Iowa	B & S	R			Ester
		Wis.	Briggs			R	Esters & amines
Blackberry	Rubus nigrobaccus	Minn.	Sch. Hans.	R			Esters & amines
Blackberry briars	Rubus sp.	Pa.	Berg.	R			Esters & amines
		Miss.	L&A	R			Esters or salts
		Ohio	CJW	R			
		Del.	DuPont	R			.2% amm. salt
Bois d'arc (See osage orange)							
Box elder	Acer negundo	Man.	Wood	S			Esters & amines
		Minn.	Kruse	S	S	S	All form.
		Nebr.	Hans.	I			Esters & amines
		Iowa	B & S	S	S	S	Esters
		Mich.	Grig.	S			
		Wis.	Briggs	S-I			Esters & amines
Buckbrush	Symphoricarpus sp.	Iowa	B & S	R			Esters--slowly killed
Buckbrush	Symphoricarpus occidentalis	Neb.	Vie.	I			Salts
Buckbrush(Coral berry)	Symphoricarpus orbiculatus	Neb.	Hans.	R			Esters & amines

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.: Fol. Sprays	Cut Surf.	Exposed Cambium	Remarks
Common Name	Scientific Name						
Buffalo berry, silver	Sherpedia argentia	Sask.	Fries.	S			Butyl ester
Cat briar	Smilax sp.	Del.	DuPont	R			.1% amm. salt
Cedar	Juniperus virginiana	Del.	DuPont	R			.1% amm. salt
		Okla.	HME	R	R		Esters--2000 ppm
Cedar, salt	Tamarix gallica	Tex.	WHM	S			When young
Cherry, choke	Prunus virginiana	Mich.	MWD	S			
		Neb.	Hans.	R			Ester, butyl
Cherry, pin	Prunus pennsylvanica	Mich.	MWD	S	S		
		Minn.	Sch. Hans.	S			Esters & amines
Cherry, sand	Prunus bessyii	Neb.	Vie.	S			Salts
Cherry, wild	Prunus sp.	Pa.	Berg.	S			Esters
		Mich.	Grig.	S			Any form.
		Wis.	Briggs		I		Esters & Amines
		Del.	DuPont	S			.2% amm. salt
Cherry, wild	Prunus serotina	Ohio	CJW	I			
		Minn.	Sch. Hans.	S			Esters & amines
Cherry, wild	Prunus virginiana	Minn.	Kruse.	I	S	S	Esters
Chestnut	Castanea sp.	Del.	DuPont	R			.2% amm. salt
Cottonwood	Populus deltoides	Ohio	CJW	R			
Cottonwood	Populus sargentii	Neb.	Vie.	S			Sodium salt
Currant, Alpine	Ribes montigenum	Calif.	Off.	R			Salts, esters, amines
Currant, Amer. black.--	Ribes americanum	Calif.	Off.	S			Salts, esters, amines
Currant, Amer. red	Ribes triste	Calif.	Off.	R			Salts, esters, amines
Currant, golden	Ribes aureum	Neb.	Vie.	S			Sod. salt
Currant, prickly	Ribes lacustre	Calif.	Off.	R	S		Salts, esters, amines
Currant, red-flowering	Ribes sanguineum	Calif.	Off.	I	S		Salts, esters, amines
Currant, Sierra Nev.	Ribes nevadense	Calif.	Off.	S	S	S	Salts, esters, amines
Currant, squaw	Ribes cereum	Calif.	Off.	S	S	S	Salts, esters, amines
Currant, sticky	Ribes viscosissimum	Calif.	Off.	I	S		Salts, esters, amines
Currant, stink	Ribes bracteosum	Calif.	Off.	S	S		Salts, esters, amines
Currant, Western black	Ribes petiolare	Calif.	Off.	S	S	S	Salts, esters, amines

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Currant, wild	Ribes floridum	Mich.	Grig.	R			
Dogbane	Apocynum canabum	Iowa	B & S	R			Esters
Dogwood	Cornus sp.	Minn.	Kruse.	S	S	S	All form.
		Mich.	Grig.	R			Salts
		Del.	DuPont	I			.4% amm. salt
Dogwood	Cornus alternifolia	Mich.	MWD	R			
Dogwood	Cornus stolonifera	Sask.	Pavl.	S			All form.
Dogwood, red ozier	Cornus stolonifera	Mich.	MWD	R			
Elderberry	Sambucus canadensis	Neb.	Vie.	I			Salts
		Ohio	CJW	I			
		Mich.	Grig.	S			Esters
Elderberry	Sambucus sp.	Pa.	Berg.	S			Esters
		Wis.	Briggs	S			Esters & amines
Elm	Ulmus sp.	Iowa	B & S	R			Esters
		Ohio	WJG	S			Esters
Elm, American	Ulmus americana	Neb.	Vie.	R			Sod. salt
		Minn.	Kruse.	S	S	S	Esters
		Neb.	Hans.	I			Ester, butyl
		Ohio	CJW	I-S			
		Mich.	Grig.	I			
		Wis.	Briggs	I-S			Esters & amines
		Okla.	HME	R	R		Esters, 2000 ppm
Elm, Chinese	Ulmus pumila	Neb.	Vie.	I			Sod. salt
		Neb.	Hans.	I			Ester, butyl
Elm, winged	Ulmus alata	Okla.	HME	R	R		Esters, 2000 ppm
Gooseberry, gummy	Ribes lobbii	Calif.	Off.	I	S		Salts, esters, amines
Gooseberry, Sierra Nev.	Ribes roezli	Calif.	Off.	S	S	S	Salts, esters, amines
Gooseberry, Siskiyou	Ribes binominatum	Calif.	Off.	R			Salts, esters, amines

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Gooseberry, white-stem--	Ribes inerme	Calif.	Off.	R	S		Salts, esters, amines
Grape	Vitus sp.	Del.	DuPont	S			.2% amm. salt
Grape, dwarf Oregon	Mahonia repens	Colo.	Mel.	R			Salts, amines, esters
Grape, wild	Vitus vulpina	Minn.	Kruse.	S	S	S	All form.
		Mich.	Grig.	S			All form.
		Wis.	Briggs	S			
Gum, cork	Liquidambar sp.	Del.	DuPont	I			.4% amm. salt
Gum, sweet	Liquidambar styraciflua	Miss.	L & A		I		Sodium salt
Hackberry	Celtis occidentalis	Neb.	Vie.	R			Sodium salt
		Okla.	HME	R			
		Ohio	WJG	S			Esters
		Okla	HME	R	R		Esters, 2000 ppm
Hawthorn (thornapple)	Crataegus sp.	Mich.	MWD	S	S		
		Mich.	Grig.	R			Esters and salts
		Wis.	Briggs			R	Esters & amines
		Del.	DuPont	R			.1% amm. salt
Hazel brush	Corylus americana	Pa.	Berg.	S			Esters & amines
		?	?	S			Sodium salt
		Iowa	B & S	R			Esters
		Wis.	Briggs	I			Esters & amines
		Minn.	Sch.Hans.	S			Esters & amines
Hazel brush	Corylus rostrata	Minn.	Sch.Hans.	S			Esters & amines
Hazel nut	Corylus cornuta	Mich.	MWD	S	S		
Hercules Club	Aralia spinosa	Del.	DuPont	S			.1% amm. salt
Hickory	Hicoria buckleyi	Okla.	HME	R	R		Esters, 2000 ppm
Holly	Ilex sp.	Del.	DuPont	R			.1% amm. salt
Honeysuckle Jap.	Lonicera japonica	Miss.	L & A	S			Ester
Ironwood	Carpinus sp.	Del.	DuPont	S			.1% amm. salt

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Ivy, poison	Rhus toxicodendron	Man.	Wood	S			Esters and amines
		Miss.	L & A	S			Esters
		Neb.	Hans.	I			Esters, butyl & ethyl
		Idaho	Erick.	I-S			Amine - July
		Ohio	CJW	I-S			Esters more eff.
		Iowa	B & S	S			Esters
		Mich.	Grig.	S			Esters & acid salts
		Wis.	Briggs	S-I			Esters & amines
		Del.	DuPont	I			.4% amm. salt
Ivy, poison woody	Rhus quercifolia	Pa.	Berg.	S-R			Esters
Ivy, wild	Ampelopsis cordata	Miss.	L & A	S			Ester
June berry	Amelanchier sp.	Mich.	MWD	S			
Laurel	Kalmia sp.	Del.	DuPont	R			.2% amm. salts
Licorice, wild	Glyceriza lepidota	Iowa	B & S	S			Esters
Lilac	Syringia persica	Neb.	Hans.	I			Esters & amines
Lilac (common)	Syringia vulgaris	Man.	Wood	S			Ester
Locust, black	Robinia pseudoacacia	Neb.	Hans.	R			Ester, butyl
		Idaho	Erick.	R			Acid, carbo.
		Del.	DuPont	S			.2% amm. salt
		Okla.	HME	I	I		Esters, 2000 ppm
Locust, honey	Gleditsia triacanthos	Neb.	Hans.	R			Ester, butyl
		Ohio	WJG	R			Esters
		Okla.	HME	I	I		Esters, 2000 ppm
Maple	Acer sp.	Del.	DuPont	R			.4% amm. salt
		Ohio	WJG	S			Esters
Maple, dwarf	Acer glabrum	Neb.	Vie.	I			Sod. salt
Maple, hard	Acer saccharum	Minn.	Kruse.	R			All form.
Maple, mountain	Acer spicatum	Mich.	MWD	R			
Maple, red	Acer rubrum	Mich.	MWD	R	I	R	
Maple, soft	Acer saccharinum	Minn.	Kruse.	R			All form.
		Ohio	CJW	I			

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Matrimony vine	Lycium halimifolium	Neb.	Vie.	S			Esters or salts
		Neb.	Hans.	R			Ester, butyl
Meadow sweet	Spirea salicifolia	Mich.	Grig.	S			Any form.
Mesquite	Prosopis juliflora glandulosa	Okla.	HME	R	R		Esters, 2000 ppm
Moonseed vine	Menispermum canadense	Iowa	B & S	S			Esters
Mulberry	Morus alba	Neb.	Hans.	I			Esters & amines
		Mich.	Grig.	R			
Oak	Quercus sp.	Pa.	Berg.	R			Esters
		Wis.	Briggs		I		Esters & amines
		Del.	DuPont	R			.2% amm. salt
Oak, black	Quercus ellipsoidalis	Minn.	Kruse.	R	S	S	All form.
Oak, blackjack	Quercus marilandica	Okla.	HME	I	R		Esters, 2000 ppm
Oak, chestnut	Quercus prinus	Del.	DuPont	R			.4% amm. salt
Oak, dwarf chinquapin	Quercus muhlenbergii	Okla.	HME	I	R		Esters, 2000 ppm
Oak, post	Quercus stellata	Okla.	HME	I	R		Esters, 2000 ppm
Oak, scrub or bur	Quercus macrocarpa	Man.	Wood	R			Apparently all form.
Oak, white	Quercus alba	Minn.	Kruse.	R	S	S	All form.
Olive, Russian	Eleagnus angustifolia	Idaho	Erick.			S	Sod. salt & amines
Osage orange	Maclura pomifera	Neb.	Hans.	R			Ester, butyl
		Iowa	B & S	R			Esters
		Okla.	HME	R	R		Esters, 2000 ppm
Papaw	Asimina sp.	Del.	DuPont	R			.4% amm. salt
Pea, Siberian	Caragana arborescens	Man.	Wood	S			Prob. all formulations
Pepper vine	Ampelopsis arborea	Miss.	L & A	S			Ester
Persimmon	Diospyrus virginiana	Del.	DuPont	S			.4% amm. salt
		Okla.	HME	I	I		Esters, 2000 ppm
Pine, loblolly	Pinus taeda	Del.	DuPont	R			.1% amm. salt
Pine, Virginia	Pinus virginiana	Del.	DuPont	R			.4% amm. salt
Pine, white	Pinus strobus	Mich.	Grig.	R			Young seed. sus.

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Plum, sand	Prunus angustifolia	Okla.	HME	I	I		Esters, 2000 ppm
Plum, wild	Prunus americana	Neb.	Vie.	I	S		Esters & salts
		Neb.	Hans.	I			Esters, butyl & ethyl
Poplar	Populus sp.	Iowa	B & S	S			Esters
		Ohio	WJG	S			Esters
Poplar, Carolina	Populus sp.	Idaho	Erick.			S	Amine salts
Poplar, tulip	Liriodendron sp.	Del.	DuPont	I-S			.4% amm. salt
Poplar, white	Populus alba	Neb.	Hans.	S			Esters & amines
Poplar, white (aspen)	Populus tremuloides	Man.	Wood	I			Sod.& amine salts & esters
		Minn.	Kruse.	S	S	S	Esters
		Mich.	MWD	I		S	
		Wis.	Briggs	S-I			Esters & amines
Privet hedge	Ligustrum vulgare	Miss.	L & A	R			Esters
Rabbit bush	Crysothamus sp.	Neb.	Vie.	S			Sod. salt
Rabbit bush	Crysothamnus nauseosus	Utah	GS	S			Tentative
Raspberry	Rubus sp.	Mich.	Grig.	R			Salts
Raspberry	Rubus strigosis	Minn.	Sch.Hans.	R			Esters & amines
Rose, wild	Rosa sp.	Colo.	Mel.	R			Salts, amines, esters
		Idaho	Erick.	R			Esters & salts
		Utah	GS	I			Tentative
Rose, wild	Rosa blanda	Neb.	Hans.	R			Esters & amines
Sagebrush	Artemisia sp.	Neb.	Vie.	S			Ester
Sagebrush	Artemisia tridentata	Utah	GS	S			Tentative
Sassafras	Sassafras variifolium	Del.	DuPont	S			.2% amm. salt
		Okla.	HME	I	I		Esters, 2000 ppm
Snowberry	Symphoricarpus occidentalis	Sask.	Fries.	R			Butyl ester
Snowberry(See buckbrush)	Symphoricarpus racemosus	Man.	Wood	R (Except when tender)			Esters
Spice brush	Benzoin sp.	Del.	DuPont	R			.2% amm. salt
Spruce, blue	Picea sp.	Ohio	CJW	R-I			
Spruce, green	Tsuga canadensis	Neb.	Hans.	R			Esters & amines

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.: Fol. Sprays	Cut Surf.	Exposed Cambium	Remarks
Common Name	Scientific Name						
Sumac	Rhus sp.	Iowa	B & S	S			Esters
		Wis.	Briggs	S-I			Esters & amines
Sumac	Rhus glabra	Neb.	Vie.	R-Summer			Sod. salt
		Pa.	Berg.	S			Esters
		Minn.	Kruse.	S	S	S	All form.
		?	?	S			Sod. salt
		Neb.	Hans.	S			Ester, butyl
		Idaho	Erick.	I-S			Amine - July
		Okla.	HME	I	I		Esters, 2000 ppm
Sumac, dwarf	Rhus capallina	Del.	DuPont	S			.2% amm. salt
Sumac, poison	Rhus vernix	Mich.	Grig.	S			Esters preferred
Sycamore	Platanus sp.	Del.	DuPont	R			.1% amm. salt
		Ohio	WJG	S			Esters
Trumpet vine	Tecoma sp.	Del.	DuPont	I-S			.4% amm. salt
Virginia creeper	Ampelopsis quinquifolia	Mich.	Grig.	S			Any form.
		Neb.	Vie.	S			Salts
		Ohio	CJW	S			
		Iowa	B & S	S			Ester
Virginia creeper	Psedera sp.	Del.	DuPont	S			.2% amm. salt
Virgin's Bower	Clematis lingustifolia	Neb.	Vie.	S-early R-summer			Sod. salt
Waahoo	Euonymus atropurpureus	Neb.	Vie.	I			Sod. salt
Walnut,-black	Juglans nigra	Neb.	Hans.	S			Ester, butyl
Willow	Salix sp.	Mich.	MWD	S			
		Iowa	B & S	S			Esters
		Minn.	Sch. Hans.	S			Esters, amines
		Okla.	HME	I			
		Tex.	WHM	S			
		Ohio	WJG	S			Esters
Willows, in general	Salix sp.	Idaho	Erick.	I			R in early spring

Woody Plants		State or Prov.	Authority	Reaction to 2,4-D Form.			Remarks
Common Name	Scientific Name			Fol. Sprays	Cut Surf.	Exposed Cambium	
Willow	Mostly Salix amygdaloides	Man.	Wood	S			Esters, amines
Willow	Salix nigra	Okla.	HME	I	R		Esters, 2000 ppm
Willow, arroyo	Salix lasiolepas	Wash.	VFB	I-S			Tentative
Willow, brittle	Salix fragilis	Idaho	Erick.			S	Acid & amines
Willow, glossy	Salix lucida	Idaho	Erick.	I			But. ester & amines
Willow, heart-leaved	Salix cordata	Idaho	Erick.	I			Acid or amines
Willow, peachleafed	Salix amygdaloides	Neb.	Hans.	S			Esters, but. & iso.
		Ohio	CJW	I			
Willow, silver	Salix discolor	Idaho	Erick.	I			Acid or amine
Willow, white	Salix alba	Wis.	Briggs	S			Esters & amines
Winter berry	Ilex verticillata	Mich.	Grig.	S			Salts

Summary of reports on pre-emergence trials.

Dunham, R. S.

In this summary, pre-emergence treatment includes any treatments made prior to emergence of the crop whether before or after planting. Three direct comparisons were reported of treatments made before planting vs. applications made after planting but before emergence. In sweet corn there was slight difference, in potatoes and onions weed control was poorer in the before planting treatment and the stand and yield of onions were greatly reduced.

Cereals: The results with corn are conflicting. In some instances there was no injury to the crop even when planted immediately after treatment; in others, corn was injured if planted sooner than 3 to 4 weeks after treatment. Several investigators reported an increased yield following treatment; others observed no stimulation of growth or yield. This variation in results is quite evidently not due to differences in formulations or rates of applications but may be due to such factors as soil, climate, and corn variety. Until the factor involved are more thoroughly understood, recommendations should be regional in scope.

Spring wheat and oats were less tolerant than corn in some areas but showed no difference in others. Fall injury to winter wheat, barley, and rye was not reflected in the yields. Apparently regional differences apply to these crops also. There was some indication of differential response of these crops to various 2,4-D formulations.

Flax: Flax was more uniformly injured than the cereals at the four locations tried when sown too soon after treatment. Approximately a month must intervene between treatment and date of sowing but rate of application was also an important factor.

Legumes: Alfalfa, sweet clover, and white clover proved susceptible to injury when sown within a month or six weeks after treatment. Peas were somewhat less susceptible and soybeans at two locations showed remarkable tolerance. There was some indication of differential response of alfalfa to formulations of 2,4-D and rate of application was an important factor.

Germination: Tests made at Minnesota on winter wheat, winter rye, oats, flax, corn, and soybeans showed no injury to the viability of seed from crops grown on land treated with 4 lbs. of active ingredient per acre.

Forage grasses: These trials were very limited. They indicate that buffalo grass and intermediate wheatgrass are quite susceptible to injury in the early seedling stage but switchgrass proved very tolerant. Sudan grass is apparently stimulated in growth when sown about two weeks after treatment. In only two trials, millet appeared very tolerant.

Vegetable crops: Limited trials indicate pre-emergence treatment of asparagus, onions, beets, carrots, spinach, tomatoes, and potatoes to be sufficiently promising to merit further research. They indicate differential results can be expected from pre-planting and post-planting applications and from different 2,4-D formulations.

Weeds: Success in controlling weeds by pre-emergence treatment varied widely from perfect control of all annuals including annual grasses in Ohio corn to very moderate control of certain broadleaf annuals and little control of grasses in Minnesota.

Direct comparisons between experiments are impossible because of varying factors. The following indications are shown in the work reported although more data are necessary before conclusions may be drawn.

1. Dormant seeds are not killed by soil treatments.
2. Weeds in general become more resistant with age; this is particularly true of the grasses. Considerable reduction in annual grasses can be accomolished.
3. Weed seedlings may grow uninhibited if there is inadequate rain and they may emerge later in the season from seeds that did not germinate earlier after toxicity has disappeared from the soil.
4. Smartweed, Russian thistle, and field bindweed seedlings were more resistant than pigweed, lambsquarters, chickweed, shepherds' purse, and purslane but there may be differences in species and strains common to various regions.

University of Minnesota, Division of Agronomy and Plant Genetics, St. Paul, Minn.

CEREALS, FLAX, LEGUMES, AND GRASSES

A study of the possible stimulation of corn by 2,4-D.

Willard, C. J. and Homer B. Neville

Because of numerous reports of stimulation of corn by 2,4-D, a definite attempt to produce stimulation by pre-emergence treatments was made. A total of 106 plots were treated at periods before planting ranging from 48 days to 22 days and also immediately after planting and at rates ranging from 1/2 to 3 pounds of 2,4-D acid equivalent per acre. In one set the plots were replicated three times and the other five times in a randomized block experiment. Heights of plants were taken during the rapid growth stage before tasseling when differences in height are most obvious. The yields of grain were taken at maturity. At no time during the season were there any visible differences between any of the plots or the checks which were in any way related to treatment. In the early planting the average yield of the untreated checks was 73.7 bushels and of all treated plots was 73.0 bushels. In the late planting the average yield of the untreated checks was 59.9 bushels and the average yield of all treated plots was 58.7 bushels. The average height varied by .1 of an inch in the early planting and .7 of an inch in the late planting. There were no significant differences in height or yield between any treatment in the series. In this experiment the treatment produced no perceptible or significant stimulation of corn in height or yield.

Ohio Agricultural Exp. Sta. in cooperation with Sherwin-Williams Co.

Pre-emergence treatment of corn with 2,4-D.

Willard, C. J. and Homer B. Neville

Corn was planted August 1 in a poor seedbed on Brookston silty clay loam soil and 2,4-D applied as concentrated (5 gallons per acre of water, 6 gallons per acre of oil) spray immediately afterwards. The butyl ester of 2,4-D was applied at rates of 1, 2, 3, and 6 pounds of acid equivalent per acre in oil & 1, 2, and 3 pounds per acre in water. The triethanolamine was applied at 1, 2, and 3 pounds per acre in water. Poor stands were obtained in all plots, includ-

ing checks, because of the poor seed-bed. The plot chosen was heavily infested with annual weeds. All 2,4-D treatments of 2 pounds per acre or more of acid controlled the annuals to the extent that no cultivation was necessary. One pound per acre of acid equivalent gave fair, but not really satisfactory, control. All annual weeds, including crabgrass and other summer annual grasses, were controlled. Hedge bindweed was definitely affected, though not completely controlled, by 2 pounds per acre and up. Canada thistle and ground cherry were not affected even by six pounds. There was no apparent injury to the stand or growth of the corn. Yields were not taken. In experiments planted earlier, where good stands were obtained, applications to 31 plots at rates ranging from 1/2 to 3 pounds per acre of acid equivalent, mainly of the butyl ester, but also of the triethanolamine and sodium salts, were made with no measurable effect on stand or yield from the treatment. Pre-emergence treatments seem definitely less likely to injure corn on these heavy soils than post-emergence treatments.

Ohio Agricultural Experiment Station in cooperation with the Sherwin-Williams Co

Weed control in corn with 2,4-D soil treatments.

Hernandez, T. P., G. F. Warren, and K. P. Buchholtz

Two replicated experiments were conducted on silt loam soil in 1947 with Golden Cross Bantam sweet corn using the sodium salt of 2,4-D. The rates of application were 2 and 4 pounds per acre of the 2,4-D acid equivalent, each being applied as a pre-planting treatment worked into the soil and as a surface application immediately after planting. In one experiment there was no reductio in stand, maturity, or yield of sweet corn. In the other, however, all 2,4-D treatments caused a delay in maturity and a reduction in yield of approximately 12 and 30 percent for the 2 and 4 pound rates, respectively. There was only a slight difference between treatments worked into the soil and those applied to the surface.

In an experiment with field corn, 2, 4, and 8 pounds of 2,4-D were applied to the surface of the soil following the planting of a single hybrid, $R_3 \times M_{13}$. The stand and yield were reduced by approximately 12, 50, and 90 percent for the 2, 4, and 8 pound rates, respectively.

Significant reductions in weed counts were obtained in all the treatments but weed control was generally better with the 4 and 8 pound applications. Compared with the checks the reduction in number was 50 to 80 percent for the grasses and 40 to 100 percent for the broadleaves. The weeds were mostly witch grass (Panicum capillari), foxtail (Setaria spp.), purslane (Portulaca oleracea), lambsquarters (Chenopodium album), and pigweed (Amaranthus retroflexus). All plots including the check were weeded at the time the counts were taken.

University of Wisconsin, Madison, Wisconsin.

Pre-emergence treatment of soybeans with 2,4-D.

Neville, Homer B. and C. J. Willard

In connection with the pre-emergence experiment with corn, three rows of soybeans were interplanted between the corn rows on all plots. Unexpectedly, they gave perfect stands in all treatments. Soybeans which were treated immediately after planting with the butyl ester of 2,4-D in oil at the rate of 6 pounds per acre of acid equivalent made a perfect stand and growth, as they

did at all lower rates. There was no difference between the soybeans in the checks and the soybeans in the treated plots in germination, standing, or growth. Yield measurements were not taken. This is contrary to the results of other experimenters here at Columbus and to our own experiments in other locations. On June 5 a patch of Canada thistles was treated with butyl ester of 2,4-D at the rate of 4 lbs. acid equivalent per acre. Soybeans were planted in this field on June 11. There was delayed emergence, some loss of stand, and stunted growth. Nevertheless, by August it was difficult to find the treated area. Another patch of Canada thistle was treated on June 20 and soybeans planted in rows on July 1 without reworking the soil. Two soil types were included in this plot, Miami silty clay loam and Brookston silty clay loam. On the Miami, a light-colored low organic soil, the stand and growth of soybeans was extremely poor -- commercially a failure. On the Brookston soil the stand and growth were injured but the damage was less severe and a partial crop was obtained. We do not recommend pre-emergence treatment of soybeans with 2,4-D, but if it could be worked out it would be more important than with corn.

Ohio Agricultural Exp. Sta. in cooperation with the Sherwin-Williams Co.

Effect of residual 2,4-D in the soil on alfalfa, sweet clover and switch grass.

Viehmeyer, Glenn and John McDermand

One, two, & four pounds per acre of 2,4-D as the sodium salt were applied to a seedbed to be planted to the above crops on April 1, April 16, May 1, and May 16, 1947. The ground was seeded on the latter date.

Alfalfa and sweet clover emerged and grew normally on soil receiving the earliest treatment. On soil receiving the April 16 treatment the stand was reduced 95% and on soil receiving the May 1 & 16 treatments no plants emerged.

Switch grass gave a full stand on soils receiving all treatments. At the heaviest application applied on the latest date (4 lbs. on May 16) emergence was delayed 10 to 15 days & seedlings showed stunting but soon recovered & made apparently normal plants. Some seed was produced on these plants.

University of Nebraska Sub.Station, North Platte, Nebraska.

Pre-emergence herbicide applications.

Dunham, R. S. and R. G. Robinson

A weed seed mixture was seeded at the rate of 75 wild buckwheat seeds, 45 wild mustard seeds, and 4 wild oat seeds per square foot on a well drained Waukegan silt loam, May 12, 1947. Oats, flax, and alfalfa were seeded with a grain drill and corn and sugar beets were planted with a Planet Jr. The soil surface was not disturbed again for the rest of the season.

On May 15 & 16 the following chemicals in water were sprayed on the soil except for the 2,4-D acid dust which was dusted. Sodium salt of 2,4-D at 1, 2, 4, and 6 pounds per acre; butyl ester of 2,4-D at 1, 2, 4, 6, and 9 pounds per acre; amine salt of 2,4-D at 1, 2, 4, and 6 pounds per acre; 2,4-D acid dust at 9 pounds per acre; ammonium thiocyanate at 22, 44, and 88 pounds per acre; 2% Sinox W at 109 & 218 gallons per acre; and Sinox General at 3 pints + 12 gallons diesel fuel oil + 87 gallons water per acre. 2,4-D rates were based on acid equivalent and treatments were replicated three times.

Oats, flax, alfalfa, sugar beets, and wild mustard had emerged by May 20. The sugar beet and corn plots were later abandoned because of uniformly poor stands.

2,4-D formulations at the 2 lb. rate eliminated mustard and alfalfa but did not significantly reduce the yields of oats and flax, even at 6 lbs. Oats and flax yields were not reduced by the sodium and amine salts; buckwheat control in June was fair at this rate. 2% Sinox W at either rate gave excellent mustard control, good wild buckwheat control in June, and no crop injury. 2,4-D acid dust, Sinox General, and ammonium thiocyanate were not satisfactory. Ammonium thiocyanate at 88 pounds appeared to be a good soil sterilizer for about 45 days. None of the treatments resulted in satisfactory control of wild oats.

Germination of flax and oats harvested from these plots was not affected by the chemical treatments.

University of Minnesota, St. Paul, Division of Agronomy and Plant Genetics.
Paper No. 611 of the Misc. Journal Series, Minn. Agricultural Experiment Station

Residual effect of 2,4-D sprayed on soil in fall.

Dunham, R. S. and R. G. Robinson

On August 31, 1946, the ammonium salt, sodium salt, and butyl ester of 2,4-D were sprayed on Waukegan silt loam soil at the rate of four pounds of active ingredient per acre. Plots were replicated four times.

On September 12, 1946, winter rye, winter wheat, and alfalfa were seeded across all plots. Rye and alfalfa were injured on all treated plots. Rye completely recovered by spring but the alfalfa winterkilled on all plots, including the check plots.

On May 10, 1947, oats, flax, alfalfa, red clover, Kentucky bluegrass, sugar beets, and corn were planted on all plots with a Planet Jr. planter without any seedbed preparation.

The 2,4-D formulations had no desirable effect on crop growth in 1947 or on the germination of seed harvested from rye, winter wheat, oats, flax, soybeans, and corn in 1947.

Marsh cress (Roripa sessiliflora), shepherds purse (Capsella bursa pastoris) and pigweed (Amaranthus retroflexus) were controlled from 33 to 100% but smartweed and black nightshade (Solanum nigrum) were unaffected.

Percentage germination of seed harvested from crops in 1947 grown on soil treated August 31, 1946. Average of four replications.

	Rye	Winter Wheat	Oats	Flax	Soy-beans	Corn
Check	99	99	43	93	94	93
Sodium salt 2,4-D	99	99	45	92	94	97
Ammonium salt 2,4-D	99	99	49	91	94	97
Butyl Ester 2,4-D	98	99	49	96	92	92

Reduction in stand of weeds in % of check. July, 1947.

Weed	Sodium	Ester
Marsh cress	60	84
Lambs-quarters	0	0
Shepherd's purse	50	75
Pigweed	100	33
Smartweed	0	0
Nightshade	0	0

University of Minnesota, St. Paul, Division of Agronomy and Plant Genetics.
Paper No. 608 of the Misc. Journal Series, Minn. Agricultural Experiment Station.

Residual effect of 2,4-D sprayed on soil in spring.

Dunham, R. S. and R. G. Robinson

On May 22, 1947, 2,4-D amine at the rates of one and two pounds per acre was sprayed on Waukegan silt loam soil. Plots were replicated three times.

On May 24, 1947, oats, flax, medium red clover, corn, soybeans, and sugar beets were planted on all plots with a Planet Jr. planter. A second planting of oats was made May 28; a second planting of corn, soybeans, & sugar beets, May 31; a second planting of flax & red clover, June 10: & a third planting of red clover, June 20. The soil surface on these plots was undisturbed after spraying except for the rows made with the planter.

The first planting of red clover was injured, and the flax stand on the first planting was slightly reduced. Otherwise, no crop injury was observed.

Lambsquarters (Chenopodium album) was well controlled, pigweed (Amaranthus retroflexus) was fairly well controlled, and black nightshade (Solanum nigrum) was unaffected. Fair control of green and yellow foxtail (Setaria spp.) was obtained for a short time on the treated plots. In the middle of July, all crops but the oats and first planting of flax were mowed because of the heavy growth of grass weeds.

The first two plantings of oats and the first planting of flax on the treated plots developed normally and seed harvested from these plots germinated as well as seed from the check plots. The low germination of all oat samples is unexplained.

Percentage germination of seed harvested from oats and flax grown on treated soil. Average of three replications.

	Oats		Flax
	Sown May 24	Sown May 28	Sown May 24
Check	22	27	98
Amine 2,4-D 1 lb/acre	28	26	98
Amine 2,4-D 2 lb/acre	25	27	95

Reduction in stand of weeds in percent of check, July, 1947.

Weed	1 lb.	2 lb.
Lambsquarters	88	93
Pigweed	15	47
Nightshade	0	0

University of Minnesota, St. Paul, Division of Agronomy and Plant Genetics.
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The effect on crop plants of pre-emergence treatments with 2,4-D.

Timmons, F. L.

Spray applications of the sodium salt, triethanolamine salt, and isopropyl ester of 2,4-D and of methoxone were made May 22 at 2 pounds per acre (acid basis) on fallow land that had been prepared for seeding crops. The sodium salt was also applied at rates of 1 and 4 lbs. of 2,4-D per acre. Duplicated single-row plantings of alfalfa, buffalo grass, corn, Midland milo, and Sudan grass were made across the treated and untreated plots May 22, June 2, & 14. Frequent showers which began May 24 totalled 2.02 inches before June 2 and 6.90 inches before June 14.

The stands of all crops from the May 22 planting were greatly reduced by all treatments with corn showing considerably more tolerance than other crops. Stands of all crops from the June 2 planting were much better but were only 7 to 39 percent for alfalfa. Stands of crops planted June 14 were nearly normal. Crop yields tended to be relatively greater than stands on the treated plots.

Detrimental effects were in proportion to the rate of 2,4-D applied but showed no clear-cut differences between the different types of 2,4-D or methoxone. Yields of milo from the June 2 planting and of Sudan grass from the June 2 and 14 plantings were, in most cases, considerably greater on treated plots than on untreated controls. The increases ranged up to 52 percent for milo and 71 percent for Sudan grass. Yields of Sudan grass on treated plots were relatively much greater for the second cutting than the first cutting.

Fort Hays Branch, Kansas Agricultural Experiment Station, Hays, Kansas.

The effects on crop plants of pre-emergence treatments with 2,4-D and Methoxone.

Timmons, F. L.

Soil applications of isopropyl ester, sodium salt, and triethanolamine salt of 2,4-D and Methoxone were made April 18, 1947, at [illegible] pounds per acre (acid basis). The sodium salt was also applied at rates of 1 to 4 pounds per acre. Duplicated single-row plantings of alfalfa, buffalo grass, corn, Midland milo, and Sudan grass were made April 18, May 2, May 22, and June 2 across the treated plots and untreated control plots. Rainfall received after treatments included: .18 inch, April 25; 3.29 inches, May 2-22; and 5.41 inches, May 2 - June 2.

Stands of all crops from the first two plantings were reduced considerably by all treatments, the reduction for the second planting being greater in most cases. Normal stands of buffalo grass, corn, milo, and Sudan were obtained on nearly all treated plots from plantings made May 22 and June 2 while alfalfa planted June 2 produced nearly normal stands. Crop yields on treated plots, expressed as percentage of yields on untreated control plots were relatively greater than stands in nearly all cases. Effects of 2,4-D reduced the yields of alfalfa and milo from the first two or three plantings but increased the yields of Sudan grass from nearly all plantings and increased the yields of corn and milo planted June 2. The increases ranged up to 38 percent more than untreated controls. No significant differences were apparent in the effects of different 2,4-D formulation or Methoxone at equivalent rates.

Fort Hays Branch, Kansas Agricultural Experiment Station, Hays, Kansas.

The effects on crop plants of pre-emergence treatment with 2,4-D.

Timmons, F. L.

Soil applications of the sodium salt and triethanolamine salt of 2,4-D at 2 pounds per acre (acid basis) and the butyl ester of 2,4-D at 2 pounds per acre (ester basis) were made August 30, 1946. Duplicated single-row plantings of winter wheat, winter barley, alfalfa, intermediate wheat grass, and peas were made August 30, September 13, September 27, and October 11 across the treated and untreated plots. A rain of 3.76 inches was received September 6 after wheat, barley, and peas had emerged. Total rainfall received September 6 to October 11 was 7.85 inches.

All treatments prevented nearly all emergence of alfalfa from the first two plantings but did not greatly reduce the stands from later seedings. The stands of peas from the second planting were reduced somewhat, but were normal for all other seedings. The stands of wheat and barley from the first three plantings were reduced only slightly. Yields of wheat were erratic but averaged about the same on treated and untreated controls. Yields of winter barley

tended to be greater on treated plots, particularly, for the first 2 plantings which winter killed much more severely on untreated plots. Yields of alfalfa were reduced relatively more than stands while yields of intermediate wheat grass showed about the same relationships as stands. The triethanolamine salt tended to reduce stands and yields of crops slightly more than did the sodium salt while the butyl ester at a lighter rate (on the acid basis) was less detrimental.

Fort Hays Branch, Kansas Agricultural Experiment Station, Hays, Kansas.

Effect on crop plants of residual 2,4-D in the soil.

Olson, P. J. and Saul Zalik

The crops involved were barley, flax, millet, alfalfa, and corn. Ester (butyl) and sodium salt were compared. One pound per acre was the rate used. The application was made May 21. Each of the crops was sown on the treated soil, and on untreated checks on five dates; namely, May 17, June 3, June 16, July 2, and July 17. For practical reasons the crop from the fifth date was used only in the case of conn. Yield of dry matter in pounds was the criterion of treatment effect.

The 2,4-D treatments did not reduce significantly the yields of any of the crops sown on the first date. Barley, millet, and corn were not adversely affected at any date. In the case of corn there was an increase in yield as a result of treatment at each date. This may have been largely due to weed control. Although the plan was to keep the crop weed free it was not practically possible to accomplish this during the earlier stages of the experiment. Alfalfa showed a significant reduction at each of the 2nd and 3rd dates, that at the 2nd being greatest. Flax showed a significant reduction at the second date only. There was no significant difference as between ester and sodium salt as to response.

Division of Plant Science, The University of Manitoba, Winnipeg, Canada.

Residual effects of 2,4-D.

Bisal, F.

Wheat, corn, peas and flax were sown 1, 18, 32, & 49 days after application of 1 and 2 pounds per acre of 2,4-D.

Corn appeared to be entirely immune to the toxic effects of 2,4-D. Both germination and vigor of growth was the same on the treated plots as on plots where no 2,4-D was applied.

Of the other crops, wheat was most resistant, followed in order by flax and peas.

Wheat seeded 1 & 18 days after the application of 2,4-D had poor germination and considerably stunted growth, but that sown 32 days after the application of the chemical was entirely unaffected, indicating that the toxic effects were dissipated completely within a month.

Flax was only slightly more susceptible to the residual effects of 2,4-D. The residual effect from neither the low nor the high rate of application of the chemical exceeded a 49 day period, however.

Peas germinated and grew poorly when seeded 32 days after the application of 2,4-D at the high rate of 2 pounds per acre, but no appreciable effect was evident from the 1-pound-per-acre rate. When seeded 49 days after treatment, peas grew normally even on plots receiving a high rate of 2 pounds per acre of 2,4-D.

Dominion Soil Research Laboratory, Swift Current, Saskatchewan, Canada.

VEGETABLES

The use of 2,4-D for pre-emergence weed control in vegetable crops.

Nylund, R. E.

A preliminary test was conducted in 1947 in which the sodium salt of 2,4-D was applied on May 22 at the rate of 9 grams per square rod to peat soil in which spinach, beet, onion, and carrot seed has been sown on May 13. The 2,4-D was applied as a dust to the soil surface using sand as a carrier. At the time of application of the 2,4-D some spinach and beets had already emerged and were subsequently killed by the acid. However, later emerging spinach and beets and the carrots and onions were not visibly injured, while all the weed species present or emerging at the time of 2,4-D application, with the exception of Lady's-tongue smartweed (Polygonum persicaria, L.), were killed. Evidently non-germinating seeds were not injured as weeds were abundant in the field later in the season. This study will be continued and expanded in 1948.

University of Minnesota, St. Paul, Division of Horticulture.
Paper No. 605 of the Misc. Journal Series, Minn. Agricultural Experiment Statio

Effect on crop plants of residual 2,4-D in the soil.

Harrison, T. B.

The 2,4-D (Herbate-Ammonium Salt 77.6% acid equivalent) was applied in liquid form on sandy soil at two strengths, namely one and two pounds per acre, down two strips a rod wide separated by a control strip on May 27 immediately after planting across these strips set onions, beets, carrots, snap beans, sweet corn, and tomato seed mixed with radish seed. One week, two weeks, and one month later similar plantings were made across the treated strips except that tomato transplants were substituted for the tomato seed mixed with radish seed.

In general the ground application of 2,4-D restricted the development of broad leaved weeds such as lambsquarters and pigweed but later the treated plots became heavily infested with five finger grass and foxtail. The stand of beets and carrots was somewhat reduced by 2,4-D applied immediately after seeding and an abnormal forking of the carrot root occurred. The yield of set onions and snap beans was also reduced by the application of 2,4-D immediately after seeding. Sweet corn and tomatoes, however, were not affected by 2,4-D. The detrimental effect of the 2,4-D on the seed and plant development of beets, carrots, snap beans and set onions had altogether disappeared after two weeks as indicated by the growth response of the plantings made two weeks after the ground application of 2,4-D.

Dominion Experimental Station, Harrow, Ontario, Canada.

Weed control in potatoes with 2,4-D.

Hernandez, T. P. and G. F. Warren

A replicated experiment was conducted with Chippewa potatoes on peat soil using the sodium salt of 2,4-D. It was applied as soil treatments at the rates of 2 & 4 pounds per acre of the 2,4-D acid equivalent, each as a pre-planting treatment worked into the soil 3 inches deep, as a surface application immediately after planting, and as a pre-emergence spray just before the potatoes came up. In addition, one treatment was applied as a direct spray of 1000 P.P.M. at 100 gallons per acre when the potatoes were approximately 8 inches tall.

The direct spray severely stunted the potatoes for a period of approximately 2 weeks but later they appeared normal. None of the treatments gave a significant reduction in yield compared with the check and there was no apparent effect on tuber quality.

The direct spray gave nearly 100 percent control of the weeds present which were mostly pigweed (Amaranthus retroflexus). As compared with the checks, the 2 pound soil applications reduced the number of weeds by 38 to 60 percent and the 4 pound applications gave a 64 to 74 percent reduction. The weeds not killed were severely stunted. Weed control was slightly better where the 2,4-D was applied to the soil surface than where it was worked in before planting.

University of Wisconsin, Madison, Wisconsin.

Weed control in asparagus.

Hernandez, T. P. and G. F. Warren

An experiment was conducted in 1947 in an eight year old asparagus bed on silt loam soil to compare the sodium salt of 2,4-D acid equivalent with Granular Cyanamid as herbicides. The treatments consisted of 4 pounds of 2,4-D per acre applied as a surface application early in the spring before any spears were showing and 375 pounds of Cyanamid per acre concentrated in an 18 inch band over the row when the weeds were about 2 to 3 inches tall. Ammonium nitrate was added to the 2,4-D plots and the checks to give the same amount of nitrogen as supplied by the Cyanamid.

Neither of the treatments effected the yield or appearance of the asparagus spears as compared with the checks. Both treatments gave approximately a 90 percent reduction in the number of weeds which consisted mostly of mouse-ear chickweed (Cerastium spp.) and shepherds purse (Capsella Bursa-pastoris).

University of Wisconsin, Madison, Wisconsin.

Weed control in onions with 2,4-D soil treatments.

Warren, G. F.

Several replicated experiments were conducted in 1947 to study the effect of applying 2, 3, and 4 pounds per acre of 2,4-D acid equivalent to peat soils as pre-planting and pre-emergence treatments to control weeds in field-sown onions. Pre-emergence sprays of the sodium salt of 2,4-D applied just before the onions broke through the ground gave from 50 to 90 percent reduction in the

number of weeds present at the time of the first weeding. The weeds which were not killed were severely stunted. The reduction was much less for the second weeding, varying from 0 to 30 percent. Four pounds per acre gave only slightly better control than 2 pounds. The treatments were about equally effective on pigweed (Amaranthus retroflexus), lambsquarters (Chenopodium album) purslane (Portulaca oleracea) and several other weeds but smartweed (Polygonum spp.) showed considerable resistance. There was no reduction in either the stand or yield of onions due to these pre-emergence sprays except in two experiments on poorly drained peat. In the latter tests, the injury varied from moderate at 2 pounds per acre to severe at 4 pounds. It is suggested that 2 pounds per acre would be an appropriate rate of application for future tests. A comparison was made of the sodium salt, amine salt, and isopropyl ester preparations as pre-emergence sprays. These three preparations gave comparable weed control but the ester reduced the stand and yield of onions by 40 percent and was therefore unsatisfactory. When 2,4-D was applied to the soil and worked in before planting, weed control was not as good as with pre-emergence sprays and the stand and yield of onions was greatly reduced.

Department of Horticulture, University of Wisconsin, Madison, Wisconsin.

Effect on crop plants of residual 2,4-D in the soil.

Bordeleau, R.

A sodium salt (Herbate C.I.L.) was applied at three different concentrations 500, 1000, and 2000 p.p.m. at the rate of 1 1/2 gallon per square rod. A check plot was provided for comparison purposes.

The soil was treated on June 17 and the first precipitation, 0.45 inches, occurred 7 hours after treatment.

Oats, white clover, corn, flax, and timothy were sown on June 17, July 5, July 21, and August 2.

Oats - At all dates of sowing germination was 100%. With the sowings of June 17 and July 5, in the treated plots, oats had a tendancy to yellow, about 50% died. However, there was no residual effect after 30 days.

White clover - Practically all destroyed at first sowing. No effect on sowings made after 15 days.

Corn - No residual effect of 2,4-D on corn.

Flax - Completely destroyed at first sowing. Good results with subsequent sowings.

Timothy - Germination 100% in all sowings. All died in all treatments as well as in the check.

Dominion Experimental Station, L'Assomption, Quebec, Canada.

The effectiveness of pre-emergence treatments with 2,4-D and Methoxone in controlling annual weeds.

Timmons, F. L.

Soil applications of isopropyl ester, sodium salt, and triethanolamine salt of 2,4-D and methoxone were made May 22, 1947, at 2 pounds per acre (acid basis) on land prepared for seeding crops. The sodium salt of 2,4-D was also applied at rates of 1 and 4 pounds per acre. A rain of .85 inch was received May 24 and rains totaling 8.79 inches were received during the next thirty days. Results were recorded July 15.

The triethanolamine salt and isopropyl ester of 2,4-D at 2 pounds per acre and the sodium salt at 4 pounds per acre reduced the stands of pigweeds, mat spurge, green foxtail, stink grass, and witch grass 92 to 100 percent & Russian thistle 80 to 90 percent as compared with untreated controls. Methoxone & the sodium salt of 2,4-D at 2 pounds per acre were somewhat less effective in controlling these species. Russian thistle was more resistant to all treatments than other small seeded species while the grasses were, surprisingly, the most effectively controlled.

Seedlings of field bindweed were not effectively controlled over the 54-day period by any of the treatments. No earlier observations were made to determine whether effective control of bindweed seedlings over a shorter period resulted from any of the treatments.

Fort Hays Branch Kansas Agricultural Experiment Station, Hays, Kansas.

The effectiveness of pre-emergence treatments with 2,4-D and Methoxone in controlling annual weeds.

Timmons, F. L.

Soil applications of isopropyl ester, sodium salt, and triethanolamine salt of 2,4-D and Methoxone were made April 18, 1947, at 2 pounds per acre (acid basis) on land that had not been tilled since fall, 1946. The sodium salt was also applied at rates of 1 and 4 pounds per acre. Part of the treated plots and untreated control plots was cultivated May 20, while the remainder was left without tillage. Little rainfall was received after the chemical treatments until May 12 after which 12.0 inches were received before June 26 when the results were recorded.

Emergence of Russian thistle (Salsola pestifer), rough pigweed (Amaranthus retroflexus), and tumbling pigweed (A. graecizans) occured before rain was received to carry the chemicals into the soil and the stands of these weeds as recorded June 26 averaged as great on treated plots as on untreated controls. However, stands of the later emerging green foxtail (Setaria viridis), stink grass (Erogrostis cilianensis), and witch grass (Panicum capillare) were reduced 57 to 89 percent by the 2,4-D treatments. On the land that was cultivated May 20 subsequent emergence of all weeds was reduced 50 to 84 percent by the different chemicals at 2 pounds per acre and 91 to 98 percent by the sodium salt of 2,4-D at 4 pounds per acre. The grasses were controlled as well as the pigweeds or Russian thistle. There was no significant differences in the effectiveness of the different chemicals at equivalent rates.

Fort Hays Branch, Kansas Agricultural Experiment Station, Hays, Kansas.

Effectiveness of 2,4-D soil treatments in controlling seedlings of three annual weeds.

Viehmeyer, Glenn and John McDermand

One, two, and four pounds of 2,4-D as the sodium salt was applied to a seedbed April 1, April 16, May 1, and May 16 to observe effects on weed populations through the growing season. Four replications of each treatment were made

The effect on stand of kochia, rough pigweed and barnyard grass was observed

The April 1 treatment was ineffective, possibly due to the effect of the chemical being lost while seeds were still dormant.

The April 16 treatment gave stand reductions for kochia 51%, 85%, 94%; pigweed 50%, 75%, 93%; barnyard grass no data (excessive growth of kochia prevented growth of barnyard grass), 79%, 98%, for the 1, 2, and 4 pound applications respectively.

The May 1 treatment, kochia 59%, 83%, 87%; pigweed 27%, 66%, 85%; barnyard grass 84%, 59%, 66% reduction for the 1, 2, and 4 pound rates. May 16 treatments, kochia 36%, 64%, 87%; pigweed 82%, 95%, 91%; barnyard grass 36%, 15%, 36% stand reduction for the 1, 2, and 4 pound dosages.

The lower reductions of barnyard grass from the May 1 and 16 treatments was apparently due to seedlings that had emerged before treatment and reached a stage where tolerance had increased.

The results, while inconclusive, indicate that additional investigation of pre-emergence treatments should be continued.

University of Nebraska Sub-station, North Platte, Nebraska.

EXPERIMENT V

EFFECT OF 2,4-D ON CEREALS, FLAX, GRASSES, CORN, AND OTHER TOLERANT CROPS

Regional Summary
Glen Viehmeyer

When 2,4-D became available to those engaged in weed control research, the first efforts were to determine the chemical's toxicity to undesirable plant life and little attention was paid to it's effect on the crop plant in which the weed was growing. This trend continued through the 1946 season but many investigators were becoming concerned at the injurious effects on treated crops. At the North Central Weed Control Conference held in Des Moines, Iowa, December 11-13, 1946, the necessity of more information on 2,4-D effects on crop plants was recognized and the Research Committee wrote Uniform Experiments V and V-2 for inclusion in the 1947 research program.

From the abstracts and reports received on Experiment V, it is quite evident that the dosages that have been generally recommended and used for the control of annual weeds in crop plants are too high for safety and that a revision of those dosages downward must be made if the maximum and most economical use of the herbicide is made. It is fortunate that such revision of dosages is possible. Reports from many sources indicate that much lower dosages will effectively control most of the serious annual weeds and this being the case, it would seem that such revision of recommended dosages is mandatory.

The case of the noxious perennial weeds with their extensive underground root systems is somewhat different. Here it becomes increasingly apparent that the minimum effective treatment for the weed will, in most cases, cause injury to the crop plant and control measures become a matter of treatment before crop is planted, after it is harvested or, as in the case of corn and the small grains, after it has developed to the point of maturity where the herbicide can no longer seriously affect yields.

A study of the abstracts indicates clearly the necessity of the revision of the recommended dosages for the control of annual weeds in crops and a clarification of the time of safe treatment in the case of noxious perennial weeds where the higher dosages are a necessity. The Research and Policy Committees must recognize that the use of 2,4-D in growing crops is no longer an experimental thing and that it is being used upon thousands of acres of growing crops in the Region. Excessive dosages can and will mean extensive losses in crop yields and for the purchase and application of unneeded chemicals.

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Experiment V-2. Varietal Differences in Crop Tolerance to 2,4-D
By - A. G. Kusch, Cerealist.

ABSTRACT

Four rates of butyl ester, viz: 1/4; 1/2; and 2 pounds per acre were used when the grain was about 4 inches high. No varietal differences were apparent on any of the four crops for the two lowest rates. However, the 1 pound and especially the two pound rate gave rise to some observable differences between varieties of the same crop.

In wheat, Rescue was effected the most, Apex somewhat less while Thatcher and Redman did not appear to be effected. The latter three varieties reacted with larger kernels and higher bushel weights. Rescue was adversely affected in this respect.

In oats, Exeter was most affected. Victory next, then Garry, with Ajax appearing to receive a stimulus. In all varieties kernels and bushel weights were increased.

In barley, Titan and Velvon were both adversely affected with Vantage and Plush showing only slight damage. In all cases, kernel and bushel weights were increased.

Contributor: Dominion Experimental Station, Scott, Sask.

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EFFECTS OF 2,4-D ON CEREALS AND FLAX

P. J. Olson,
Saul Zalik
Division of Plant Science
The University of Manitoba

ABSTRACT

Two formulations, ester (butyl) and sodium salt were applied to each of four crops, namely Redman wheat, Garry oats, Montcalm barley and flax. The application was made at 3 rates: 1/2 lb., 1 lb., and 2 lbs., per acre (pure acid equivalent) in the case of wheat, oats and barley, and 1/4 lb., 1/2 lb., and 1 lbs., in the case of flax. The applications were made on each of 2 dates, when the plants were respectively approximately 8 to 10 inches tall, and when they were just beginning to head (cereals) and bloom (flax).

The ester produced much more damage than the sodium salt in all cases. The sodium salt actually produced no damage that could be measured by statistically significant differences in yield between treatments. In the case of ester the least damage was done to wheat. The 1/2 lb. rate did no damage to wheat or oats. The damage from the 2 lb. rate was severe in all cases. The 1/4 lb. rate did relatively little damage to flax, but the damage from the 1/2 and 1 lb. rate was severe.

The later application of ester did not produce significantly greater damage than the earlier one except in the case of barley. Here the effect of treatment at the second date was much more severe. Highly significant reductions in yield took place at all three dates. The reduction at the 1 and 2 lb. rates was more than 40 and 50 per cent respectively.

October, 1947

Effect of Sodium Salt and Ester (butyl) of 2,4-D on Wheat, Oats, and Barley and Flax measured in Yield of Crop (bushels per acre).

REDMAN WHEAT

	Ester			Sodium Salt		
	First Date	Second Date	Average	First Date	Second Date	Average
Check	24.9	25.6(1)	26.0	27.4	26.0	26.0(1)
1/2 lb.	22.6	24.6	23.6	22.1	25.9	24.0
1 lb.	25.5	17.5(2)	21.5	21.4	23.1	22.2
2 lb.	19.4	17.2(2)	18.3	25.6	24.6	25.1

(2) Significantly different from check (Necessary difference 3.9)

GARRY OATS

Check	31.8	41.2	33.9(1)	30.2	32.6	33.9(1)
1/2 lb.	28.5	29.3	28.7(2)	35.8	39.2	37.4
1 lb.	19.9	15.9	17.9	36.9	37.8	37.4
2 lb.	11.8	18.8	15.3	32.7	25.6	29.2

(2) Significantly different from check (Necessary difference 7.3)

MONTCALM BARLEY

Check	51.8	54.8	53.3(1)	51.8	54.8	53.3(1)
1/2 lb.	45.0(2)	34.3(2)(3)	39.7(4)	54.2	53.8	54.0
1 lb.	46.6	27.4(2)(3)	36.5(4)	50.9	49.1	50.0
2 lb.	38.4(2)	19.9	29.1	45.1(2)	53.0	49.0

(2) Significantly different from check (Necessary difference 5.9)
(3) Significantly different from corresponding treatment of first date (Necessary difference 6.8)
(4) Significantly different from check (Necessary difference 4.2)

ROYAL FLAX

Check	28.2	30.6	29.4(1)	29.1	30.0	29.4(1)
1/4 lb.	24.0	25.2	24.6(2)	29.0	33.2	31.1
1/2 lb.	19.1	21.0	20.0(2)	27.9	31.1	29.5
1 lb.	16.0	17.1	16.5(2)	26.8	26.4	26.6

(2) Significantly different from check (Necessary difference 3.0)

(1) Average Ester and Sodium Salt checks

THE EFFECT ON THE YIELD OF WHEAT, OATS, BARLEY & FLAX SPRAYED WITH 3 FORMULATIONS OF 2,4-D, 5 CONCENTRATIONS AND AT 3 STAGES OF GROWTH.

Author: H. W. Leggett

WHEAT: All wheat plots treated in the 3 leaf stages produced distorted heads i.e. Clubbing, Twin Heads, etc. This distortion was totally absent from the two stages following. In the two latter stages, treated with 3, 4, and 5 pounds of acid in all formulations but more noticeable in the Amine and Ester formulations, the percent of sterile florets ranged from 15 to 60% as the concentration increased. The over-all picture seems to be that except for distorted heads produced by early spraying, less damage results from early spraying than late spraying.

BARLEY: (Sanalta) Distorted heads while much more general in the 3 leaf stage spraying also were found in the plots sprayed at other stages. Sterile florets were in the same range and stages as those of the wheat sprayed in the last two stages. It is interesting to note that both in barley and wheat there were very few sterile florets observed from spraying in the 3 leaf stage. After spraying the barley plots, without exception, appeared to be badly damaged as though hit by 5° of frost but they came back extremely well and all matured within six days of the check plot.

OATS: (Larain) The oat plots appeared to be the least resistant cereal to 2,4-D treatment. Plots sprayed in the 3 leaf stage showed the least damage and of these plots no distorted heads were observed. The roots of the oat plants showed distinct damage while those of wheat and barley plants showed damage only on plots treated with four and five pounds of the acid. The percentage of sterile florets increased with formulation, concentration and stage respectively. Ranging throughout the 46 plots from 2% in the check plot to 70% in the 5# Butyl Ester plot sprayed in the pre-heading stage.

FLAX: (Redwing) The flax plots showed a very definite cut-off line as regards concentrations of the various formulations. All of the 5# concentration plots were completely wiped out and the other, for which no yield is shown on the table, produced no seed. The one point that stood out in the flax plots was date of maturity. Compared with the check plot the maturity of the Sodium Salt plots were delayed 3, 5, and 7 days, as the concentration increased, Amine plots were delayed 5 and 7 days; and Butyl Ester plots were delayed 6 and 9 days. There was no difference in regard to stage of growth when treated.

Plot No.	TREATMENT	AVERAGE YIELD IN BU./ACRES WHEAT 3 reps	BARLEY 3 reps	OATS 3 reps	FLAX 3 reps
Stage	3 leaf				3"-5" height
1	Check	62.7	76.0	99.2	25.9
2	1# Sodium salt	62.0	70.1	94.0	24.6
3	2# " "	57.6	71.1	101.1	21.6
4	3# " "	50.0	67.3	96.4	20.2
5	4# " "	46.1	69.8	89.7	00.0
6	5# " "	42.8	54.7	75.0	00.0

Continued on page 5

7	1# Amine	60.5	70.0	92.3	22.9
8	2# "	57.4	72.3	93.6	23.8
9	3# "	50.5	58.4	86.0	00.0
10	4# "	48.4	61.1	74.2	00.0
11	5# "	43.3	55.3	60.2	00.0
12	1# Butyl Ester	56.9	75.2	74.2	23.4
13	2# " "	54.7	75.8	72.9	21.1
14	3# " "	53.2	63.3	65.9	00.0
15	4# " "	50.3	56.4	61.6	00.0
16	5# " "	46.1	48.8	59.1	00.0
Stage	Early Shot Blade				7" - 9" height
17	1# Sodium Salt	60.5	81.1	98.8	24.8
18	2# " "	57.0	74.6	104.0	23.0
19	3# " "	62.9	73.1	88.8	17.9
20	4# " "	60.6	73.3	81.5	00.0
21	5# " "	56.4	64.4	64.6	00.0
22	1# Amine	63.4	80.7	100.8	24.0
23	2# "	57.9	78.2	77.6	17.4
24	3# "	51.8	69.9	70.2	00.0
25	4# "	49.1	69.8	52.4	00.0
26	5# "	45.2	68.6	46.1	00.0
27	1# Butyl Ester	52.8	67.6	53.2	21.6
28	2# " "	47.4	67.6	28.4	16.6
29	3# " "	45.0	63.3	13.8	00.0
30	4# " "	36.2	49.9	13.8	00.0
31	5# " "	21.7	44.9	12.0	00.0
Stage	Pre-heading				Pre-bloom 12"-14" height
32	1# Sodium Salt	54.3	72.5	100.5	20.9
33	2# " "	49.9	74.9	97.7	19.1
34	3# " "	46.5	63.4	95.1	8.2
35	4# " "	47.0	59.1	85.7	0.0
36	5# " "	36.6	55.2	80.3	0.0
37	1# Amine	52.8	75.0	101.0	12.9
38	2# "	49.3	68.2	88.4	7.2
39	3# "	42.0	62.2	84.9	0.0
40	4# "	41.5	50.4	72.1	0.0
41	5# "	36.0	48.6	62.1	0.0
42	1# Butyl Ester	49.4	63.0	87.5	14.6
43	2# " "	41.8	57.1	71.9	6.7
44	3# " "	32.7	38.3	33.1	0.0
45	4# " "	13.5	32.8	20.0	0.0
46	5# " "	5.8	27.2	19.0	0.0
F	Values Reps	1.59	16.11	0.63	0.67
	Treatments	33.28	12.55	16.43	86.81
SIGNIFICANT DIFFERENCE		5.88 bu	9.70 bu	18.64 bu	15.61 bu

Dominion Experimental Station, Lacombe, Alberta

30915jc-12/47

ABSTRACT

V - Effect of 2,4-D Sprays on Cereals, Flax, etc.
Wheat
Oats
Barley
Flax,

By J. P. Ficht

All crops were sprayed with Chipman's (Sodium Salt 60 per cent) Naugatuk (Amine 30 per cent) and Weed-No-More (Ester 32 per cent) at 1/4 and 1/2 pound per acre.

Wheat (Rescue) sprayed when three inches high developed deformed heads and a noticeably uneven stand at both rates with all chemicals. Date of heading and maturity delayed 3 to 6 days.

Wheat sprayed just before emergence and after plants were five inches high did not develop deformed heads. No significant delay in maturity.

Oats (Ajax) and barley (Titan) sprayed at height of three inches showed a noticeable uneveness of stand with heading and maturity delayed three to six days.

Flax (Royal) sprayed at early four-leaf stage showed severe reduction of stand from Naugatuk at one-half pound, and Weed-No-More at one-quarter and one-half pound per acre. Flax sprayed in bud stage with one-half pound Naugatuk branched more profusely and filled with seed, but was retarded about two weeks in maturing. Similar results were observed on a farm where flax was sprayed when about four inches high.

Dominion Experimental Station,
Swift Current, Sask:, Canada.

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Some Effects of 2,4-D Sprays on the Yields and Growth of Barley and Oats

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

Experiments were conducted in 1946 and 1947 to determine the effect of several 2,4-D top sprays on the yielding ability, seed germination, kernel weight and lodging resistance of Oderbrucker barley and Vicland oats. Both sodium salt and butyl ester preparations of 2,4-D were used and were applied at the 4, 8, and 14 inch growth stages of the grain. In 1946, rates of 1, 2, and 4 pounds per acre of the 2,4-D acid equivalent were applied but in 1947 they were reduced to 0.5, 1, and 2 pounds per acre. The experimental area was essentially weed free.

The various sprays failed to affect the yield of barley significantly in either 1946 or 1947. Germination of seed from the treated plots was fully as good as from the untreated plots. Kernel weight of the barley was increased significantly by treatment at the 4 and 8 inch growth stages. Lodging was reduced significantly in several instances by the 2,4-D treatments.

Oat yields were depressed significantly by a number of the spray treatments. The higher rates of application and applications at the 4 and 8 inch growth stage were particularly depressing and resulted in yields but from 60 to 80 per cent of check. Germination was reduced significantly by 7 of the 18 treatments and particularly by the heavier rates at the 4 and 8 inch growth stages. Neither kernel weight nor lodging reaction was influenced materially by the different treatments. The sodium salt of 2,4-D was significantly less toxic than the butyl ester to the oat plants in both 1946 and 1947.

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Chemical Control of Weeds in Flax

A. L. Bakke
Iowa Agricultural Experiment Station

Previously Sinox and Dow Selective in dilute concentrations have been recommended as herbicides for the control of annuals in flax. The Sherwin-Williams Company of Cleveland, Ohio, manufacturers of Weed-No-More cooperated with the Iowa Agricultural Experiment Station in ascertaining whether a dilute solution of Weed-No-More could not be used. Concentrations of Weed-No-More 40 ranging from 1/8 of a pint to one pint per acre in 100 gallons of water were used to spray flax at Kanawha, Iowa, where Pennsylvania smart weed infestation was heavy. The results were as follows: 1/8 pint 22.86 bushels per acre, 1/4 pint - 18.45 bushels; 1/2 pint - 20.68 bushels; and one pint - 17.25 bushels. Sinox W. in the recommended concentration yielded 14.76 bushels per acre; Dow Selective 18.76 bushels. Santobrite (sodium pentachlorophenate) 1/2 per cent yielded 18.86 bushels. From the data gotten at Kanawha, Iowa, it is evident that a dilute solution of Weed-No-More (butyl ester) can be used to control weeds like the Pennsylvania smart weed. At Crystal Lake, Iowa, Dow Selective yielded 22.19 bushels per acre, Santobrite (1/2 per cent) 24.22 bushels, and the control 1.2 bushels.

Yields per acre from chemical treatment of flax 8-10 inches high - June 14, 1947 at rate of 100 gallons per acre. Kanawha, Iowa.

Chemical	Infestation per sq. ft. smartweed	No. of plants in rod row - time of harvest		Weight per bushel	Yield per acre bushels
		Flax	smartweed		
Weed-No-More					
1/8 pt.	2300	182	27	52.2	22.86
1/4 pt.	"	186	33	52.2	18.45
1/2 pt.	"	154	65	51.6	20.68
1 pint	"	150	150	___	17.25
Weed-No-More dust 10%	"	188	42	52.4	22.40
Sinox W	"	200	350	___	14.76
Sinox Dust	"	146	31	48.2	19.18
Dow Selective	"	122	39	49.6	18.76
Dow Selective (Corn Stalk Ground)	"	194	53	___	15.80

Continued on page 8

Santobrite					
1/2%	2300	185	28	____	18.86
1/4%	"	259	219	____	17.30
Control-no treatment	"	217	114	49.2	17.15

Crystal Lake, Iowa

Dow Selective	Heavy	486	34	52.8	22.19
Santobrite					
1/2%	"	549	5	53.6	24.22
Control	"	481	70 (40")	____	1.2

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Spraying oats with 2,4-D

A. L. Bakke

Iowa Agricultural Experiment Station

Oats (Clinton) 8-10 inches tall heavily infested with Pennsylvania smart weed and other annuals was sprayed with various chemicals. The data have been recorded in the following table:

Yields per acre from chemical treatment of Clinton oats 8-10 inches high June 19, 1947 - Kanawha, Iowa. Principal weed - Pennsylvania smartweed - three inches, 36 per sq. yd. - 100 gallons per acre.

Chemical used	Concentration 100 gals.	Weight per bushel	Yield per acre bushels
Weed-No-More 40	1/8 pint	36.5	74.02
	1/4 pint	38.0	66.84
	1/2 pint	37.6	58.11
	1 pint	37.8	55.29
	10 gal. per acre	37.2	61.29
No treatment	Control	37.4	67.53
Sinox W	4 pints	38.2	57.29
Santobrite *	4 lbs.	37.7	69.93
	2 lbs.	36.0	68.93
Tufor 40	1 quart	36.6	93.94
Dow-Sodium salt	20 oz.	36.8	95.03

* Sodium pentachlorophenate.

Solutions as dilute as 1/8 pint per acre of Weed-No-More controlled the annual weeds in oats. Oats sprayed with the amine formulation (Tufor 40 - one quart) gave higher yields than the control; the same was true for the sodium salt (Dow).

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EFFECT OF 2,4-D SPRAY ON SPRING PLANTED KANOTA OATS

W. C. Elder (1)

Three types of 2,4-D were applied on Kanota spring oats when 3 to 4 inches high and again just before the heading stage. 1/2 lb., 1 lb., 1 1/2 lbs., and 2 lbs., per acre was applied at the rate of 1 1/2 gal. per sq. rod.

The 1 1/2 lbs. and 2 lbs. per acre applications lowered yields more on the 3 to 4 inch oats than applications made just before heading. The 1/2 lb. and 1 lb. per acre plots gave yields very similar for both dates of application. All 1/2 lb. per acre plot yields were 10% to 15% lower than check plots. The 2 lbs. application gave a decreased average yield of 25% to 30%. The ester type gave lower yields than the salt and amine types when the 1 1/2 lbs. and 2 lbs. per acre applications were used.

(1) Assistant Agronomist, Oklahoma A & M College.

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The effect of Different Types of 2,4-D Formulations at Various Rates of Application on Winter Wheat at Two Stages of Growth (NCWCC Uniform Exp. No. V, 1946-47)

F. L. Timmons (1)

Duplicated spray applications were made October 20, 1946, on weed-free Comanche winter wheat in the tillering stage, comparing the sodium and trieth-anolamine salts of 2,4-D at 2, 3, and 4 pounds per acre (acid basis) and the butyl ester of 2,4-D at 1, 2, and 3 pounds per acre (.8, 1.6, and 2.4 lbs. of 2,4-D). Duplicated spray applications were made April 7, 1947 and on adjacent area in the same field comparing the same 2,4-D formulations at .5, 1.0, 1.5, and 2.0 pounds per acre (acid basis). The wheat was six inches tall and beginning to joint. No weeds were present. The rates tested in the fall applications are those that would normally be used in spraying perennial weeds in growing wheat while those tested in the spring treatments are comparable with rates used in selective spraying of annual weeds in small grain.

All fall treatments reduced tillering, delayed maturity, and caused poor exertion of wheat heads. Yields were reduced 23, 39, and 51 per cent respectively, by the amine salt, sodium salt, and butyl ester at 2 pounds per acre and 40, 55, and 50 per cent, respectively, by the same chemicals at 3 pounds per acre. The spray applications made April 7, 1947, retarded growth of wheat only temporarily, the effect being most noticeable on plots sprayed with the butyl ester. Wheat yields on spring treated plots were variable due to differential lodging, but there were no consistent trends in the yield data and no significant reductions or increases in yield due to 2,4-D treatment.

(1) Agronomist, Bureau of Plant Industry, Soils and Agricultural Engineering, U. S. D. A. cooperating with the Fort Hays Branch of the Kansas Agricultural Experiment Station.

Summary of data on the effect of different types of 2,4-D formulations at various concentrations on winter wheat at two stages of growth. NCWCC Uniform Exp. No. V, 1947 conducted at the Fort Hays Experiment Station, Hays, Kansas.

2,4-D product and type of formulation	Rate of application lbs. of 2,4-D per acre	Per cent normal vigor of crop (2) 4/21/47	Yield of Wheat (2) Bu./A	Yield of Wheat (2) % of Controls
Spray applications made October 20, 1946				
Chipman 2,4-D (Sodium salt)	2	88	24.3	61
	3	75	18.0	45
	4	60	19.1	48
Weed-No-More (Butyl ester)	1*	83	22.2	55
	2*	60	19.6	49
	3*	65	20.1	50
Tufor 40 (Triethanolamine)	2	85	30.7	77
	3	65	23.9	60
	4	80	23.3	58
Untreated controls	-	-	40.1	-
Spray applications made April 7, 1947				
Chipman 2,4-D (Sodium salt)	.5	98	33.9	93
	1.0	95	39.1	108
	1.5	98	26.5	73
	2.0	95	38.6	106
Weed-No-More (Butyl ester)	.5	98	33.4	92
	1.0	70	36.1	100
	1.5	80	36.5	101
	2.0	75	33.9	93
Tufor 40 (Triethanolamine salt)	.5	95	40.8	112
	1.0	98	36.7	101
	1.5	95	30.2	83
	2.0	95	38.6	106
Untreated controls	-	-	36.3	-

(1) All treatments applied as spray at 160 gallons per acre.
(2) Data given are averages of duplicate plots for all treatments and of five replicate control plots.
* Weight of butyl ester of 2,4-D which contain 80% of 2,4-D equivalent.

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Title - Effect of 2,4-D on winter wheat
Author - C. J. Willard
Ohio Agricultural Experiment Station in cooperation with Dow Chemical Company.

Winter wheat was treated with 2,4-D in 1946 and 1947. In 1946 a standard rate of 4 pounds per acre of 2,4-D acid was used. In 1947 rates from 1/2 pound to 2 pounds per acre were used.

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Yields of wheat were obtained from square yard samples in each year but the non-uniformity of the land in 1947 made the yield results totally non-significant. In 1946 there was no apparent damage or loss in yield from treatment April 5th in the rosette stage. Treatments May 8th at the shooting stage cut the yield from nearly a half to two-thirds, the action of the esters being much more severe. A similar but slightly less loss occurred on May 22 when treated when the heads were appearing. There was some injury and loss in yield even when treated at the end of bloom on June 6th. Treating on June 20 had no effect on yield. In 1947 the ester caused significant reduction in yield on May 27 at all rates greater than 1/2 pound acid equivalent per acre. This was obvious from the apperance of the plots of the field. Apparently winter wheat will stand rather moderate rates of treatment without material injury in the rosette stage in the early spring but at later stages is likely if the rate of application exceeds 1/2 pound acid equivalent per acre. After the milk stage there is no apparent injury to the crop.

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Experiment V. Effect of 2,4-D Sprays on Wheat
W. C. Elder (1)

An ester type and a salt type of 2,4-D were applied at the rate of 1 1/2 gal. per sq. rod each of 1/2 lb., 1 lb., 1 1/2 lb., and 2 lbs. per acre on Pawnee wheat just at the start of the jointing stage. The same procedure was used on the wheat at the start of the heading stage. The last application was made at the time considered best for 2,4-D applications on bindweeds in spring.

Only slightly higher yields were harvested on tests made at the start of the jointing stage compared with treatments made at the start of the heading stage. There was no difference in yields from the acid type and ester type of 2,4-D applications.

The 1/2 lb. per acre applications gave a slight decrease in yield compared with check plots. The 2 lbs. per acre applications gave a 15% decrease in yields.

An application of 2,4-D was made on wheat in the fall months at stooling stage. It appears that this early application is more severe on wheat yields than spring applications. Fall applications produced poor stools and delayed maturity.

(1) Assistant Agronomist, Oklahoma A & M College

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Spraying Corn with 2,4-D
A. L. Bakke
Iowa Agricultural Experiment Station

June 28, 1947 - Early stage - Crystal Lake, Iowa - 1 qt. Weed-No-More per 100 gallons per acre. One spraying - one cultivation - 730 lbs., 1/4 acre plot. Not sprayed - 2 cultivations - 725 pounds, 1/4 acre plot.

June 19 - Early stage - Kanawha, Iowa.

100 stalks - Weed-No-More 1/4 pt. per acre - 2nd & 4th cultivations - 45.5#
100 stalks - " " " 1/2 pt. " " - " " " - 42.0#
100 stalks - not sprayed - 4 cultivations - - - - - - - - - - - - - - - 42.0#

Experiment V - Effect of 2,4-D Sprays on Corn

In this experiment, three forms of 2,4-D, Viz., sodium salt, amine and methyl ester, were used at the rates of 0.5, 1.0, and 1.5 pounds of 2,4-D acid per acre. The spray was applied to the corn hybrid Canada 645 on June 25th, when the plants were six inches high and in the five leaf stage, using one gallon of spray per square rod.

Based upon the limited data that is available, the results would indicate the following:

1. Only with the heaviest application of methyl ester (1.5 pounds) was there any great reduction in stand.
2. There was some recovery from injury, the greatest being in the plots receiving the lowest rate of 2,4-D.
3. In all cases the degree of injury increased with heavier rates of application. Of the three forms of 2,4-D the methyl ester was the most severe.
4. Many plants in the methyl ester plots showed a rolling of the leaves tightly encasing the tassel.
5. By the end of July, the plants showed a high degree of recovery but those in the methyl ester plots were still about a foot shorter than those in the other plots.
6. No yield data can be supplied at this time.

G. F. H. Buckley,
Sr. Assistant, Forage Crops,
Dominion Experimental Station, Harrow, Ontario

Date planted - May 30, 1947 Corn Hybrid Used - Canada 645
Date of Treatment - June 25, 1947
Plot size - 22 hills (2x11); 42" rows); 3 replications.

Treatment Number	Treatment Application-1 gal. of spray per sq. rd. Rate of comp. per acre	Number of plants per plot 6/25	Number of plants per plot 7/8	% reduction in stand	No. plants showing severe effects 6/30	No. plants showing severe effects 7/3	% of plants showing injury on July 3
1	0.5 lbs. Amine	59	57	3.4	10	5	8.8
2	1.0 lbs. Amine	63	61	3.2	16	13	21.4
3	1.5 lbs. Amine	64	63	1.6	22	12	19.0
4	0.5 lbs. Methyl ester	59	59	0.0	15	12	20.4
5	1.0 " " "	62	61	1.6	27	22	36.7
6	1.5 " " "	63	57	9.5	25	25	43.9
7	Check - no treatment	64	64	0.0	0	0	0
8	0.5 lbs. Na. salt	64	62	3.1	15	5	8.1
9	1.0 lbs. Na. salt	58	58	0.0	16	12	20.7
10	1.5 lbs. Na. salt	62	61	1.6	23	15	24.6

Note: As corn will not be harvested before November 1st, no yield data can be supplied at this time.

Result of Uniform Experiment V
Effect of 2,4-D Sprays on Corn

Applications of 0.25, 0.5, 1.0 and 1.5 pounds of 2,4-D (Sodium Salt) per acre in 120 gallons of water was applied to corn 10 to 12 inches in height. The average yield on check plots was 69.8 bushels per acre, compared to 69.2, 70.6, 66.9, and 65.5 on plots sprayed at the rate of 0.25, 0.5, 1.0 and 1.5 pounds per acre respectively. Amounts up to 1 pound per acre did not materially effect yields while 1.5 pounds of 2,4-D reduced the yield over check plots 4.3 bushels.

One pound of 2,4-D (Sodium Salt) per acre was applied as a spray to corn 6, 12, 20 and 30 inches in height. Yields were -5.8 bushels on plots sprayed when corn was at a height of 6 inches, +1.3 bushels on 12 inch corn, -5.8 bushels on 20 inches corn, and -2.7 bushels when corn was sprayed at a height of 30 inches compared to check. Average yield for check plots was 85.2 bushels per acre. Other experiments have shown that damage to large corn can be reduced by applying sprays with a row crop sprayer in such a manner as to allow a minimum amount of spray to come in contact with the top of the corn plant. While no difference was noted between side or over the top applications on small corn.

Oliver C. Lee
Agric. Expt. Station
Purdue University
Lafayette, Indiana.

Table 1. Yields of corn expressed in bushels per acre on plots sprayed, applying 0.25, 0.5, 1.0, and 1.5 lbs. of 2,4-D acid per acre and check.

Treatment	Check	0.25	0.5	1.0	1.5
Ave. yields	69.8	69.2	70.6	66.9	65.5
Difference		-.6	+1.2	-2.9	-4.3

Table II. Yields of corn, in bushels per acre, from plots sprayed with 2,4-D, rate of 1 lb. per acre, at various stages of growth and checks.

Height of corn	6 in.		12 in.		20 in.		30 in.	
	Check	Sprayed	Check	Sprayed	Check	Sprayed	Check	Sprayed
Ave. yield	85.2	79.4	85.1	86.4	71.3	65.5	67.4	64.7
Difference		-5.8		+1.3		-5.8		-2.7

Table III. Yields of corn in bushels per acre on plots sprayed over the corn and from the side when corn plants were 12 and 30 inches tall and checks.

	Corn 12 in. tall			Corn 30 in. tall		
Treatment	Check	Over	Side	Check	Over	Side
Ave. yields	85.1	83.9	84.8	73.4	65.4	71.3
Difference		-1.2	- .3		-8.0	-2.1

Title - Treating corn with 2,4-D - post emergence
Author - C. J. Willard
Ohio Agricultural Experiment Station in cooperation with the Dow Chemical Company and Sherwin-Williams Company

Preliminary tests in 1945, 96 plots in 1946, and 28 plots in 1947 were devoted to a study of the effect of 2,4-D as a direct application to corn. The 1946 applications were of solutions made up at 0.1% and 0.2%, applied directly to the corn. Since the corn occupied only a small area of the field, it is difficult to state this in terms of pounds per acre. The corn plants were thoroughly wet. It would certainly be equivalent to at least 2 and 4 pounds per acre respectively. The sodium salt, triethanolamine and 3 esters were applied at 8 different dates beginning when the corn averaged 10 inches high and ending two weeks after tasseling, or about the milk stage. In 1947, the butyl ester was applied at several rates when the corn was 30 to 20 inches tall. All treatments of two pounds per acre or more before the tasseling stage obviously damaged the corn and significantly reduced the yield. The reduction in yield ranged from a third to a half, mostly around a third. In 1947 one pound per acre did perceptible damage but the corn outgrew it and the yield was not significantly reduced. We would conclude that any direct application to corn should not be heavier than one pound of 2,4-D acid per acre, and preferably less. In both 1945 and 1946 2,4-D sprays applied to weeds on the ground, hitting just the bases of the corn stalks, usually do not reduce the yield at all. Where the yield was apparently reduced the loss was not statistically significant and very much less than that from the same amount of spray applied to the corn.

Detailed Data, Butyl Ester of 2,4-D on 20 to 30 inch corn. Columbus, Ohio, 1947. Hybrid C38, applied July 21.

Plot No.	2,4-D acid equivalent per acre	Type of spray	Yield per acre - replication			
			1	2	3	Average
	lb.		Bu.	Bu.	Bu.	Bu.
1, 12, 24	0.2	Dilute	60.0	61.0	58.2	59.7
5, 17, 14	0.2	Conc.	76.0	60.8	64.2	67.0
2, 10, 28	0.4	Dilute	68.8	52.7	58.9	60.1
6, 22, 15	0.4	Conc.	65.5	61.6	57.7	61.6
3, 27, 20	0.6	Dilute	57.8	54.9	50.9	54.5
25, 27, 9	0.6	Conc.	50.1	60.1	58.4	56.2
19, 4, 16	1.0	Dilute	63.8	61.7	64.1	63.2
21, 18, 8	1.0	Conc.	59.6	60.8	63.8	61.4
13, 26, 11, 23	Check		59.9	67.3	61.0	53.1 60.3

Effect of several herbicidal preparations on the growth and yield of corn.

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

A corn single hybrid, R3 x M13, was planted in replicated 20 hill plots and top sprayed with the butyl ester and with the sodium, ammonium, and amine salts of 2,4-D at the rate of 1 pound of the acid equivalent per acre when the corn was 20 inches high. Of the dinitro materials such as Dow Selective and Sinox, the former was applied at the rate of 3 pints to the acre and the latter at 1/2 gallon per acre with 1 1/2 pounds of activator.

All of the 2,4-D preparations caused marked proliferation of the brace roots and caused the corn stalks to bend. A number of the stalks were broken off soon after treatment by wind and cultivation. Nearly equal brace root injury appeared to be caused by the different preparations. Plots treated with sodium salt had 62 per cent bent plants while those treated with the other preparations had approximately 75 per cent. Plant breakage varied from 12 to 34 per cent, being lowest with the sodium salt and highest with the butyl ester. The Dow Selective burned the corn leaves severely while the plants treated with Sinox were nearly unaffected.

The grain yields varied from 52 to 70 per cent of check, being 39.3, 43.0, 47.2, and 52.8 bushels per acre respectively, for the plots treated with the butyl ester, amine, ammonium, and sodium salt preparations of 2,4-D. All of these yields are significantly less than check. The grain yields from the dinitro treated plots were not significantly less than check, being 94 and 100 per cent of the check for the Dow Selective and Sinox treatments respectively.

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Effect of date and rate of 2,4-D application on the growth and yield of corn.

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

Two single hybrids, R3 x M13 and 153 x 25, were planted in replicated 20 hill plots. Plots were sprayed at the 10, 20, and 40 inch growth stages with 0.5, 1.0, and 2.0 pounds of 2,4-D acid equivalent as the sodium salt. The 10 and 20 inch applications were over all top sprays. The 40 inch application was applied from the side to the lower 30 inches of the plants.

Corn brace root proliferation was especially severe following the applications at the 20 inch growth stage. There was only a slight amount of proliferation on plots treated at the 10 inch stage and none on those threated when the corn was 40 inches high. The heavier treatments produced a bending of 50 per cent of the stalks following treatment at the 10 inch stage. At the 20 inch stage bending was even more severe with percentages of as much as 70 per cent. No bending was noted after the 40 inch application. Loss of plants due to stalk breakage was greatest on the heavier application made at the 20 inch stage. Proliferation of roots and degree of stalk bending and breakage was distinctly greater for the R3 and M13 hybrid than for 153 x 25. Grain yields were reduced significantly by all treatments made at the 20 inch stage and by the heavier treatments made at the 10 inch stage. Reductions of as much as 36 per cent were recorded. None of the treatments at the 40 inch growth stage reduced yields significantly.

Effects of 2,4-D sprays on growth and yields of several corn hybrids.

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

Wisconsin yellow dent double hybrids W355, W464, W606, W641A, W692, single hybrid R3 x M13 and Golden Cross Bantam sweet corn were grown in replicated 20 hill plots. When 20 inches tall they were sprayed with the sodium salt of 2,4-D at the rate of 1 pound of the acid equivalent per acre. The area was cultivated 3 times and hoed twice to prevent interactions due to weed growth.

The 2,4-D spray caused proliferation of the dent corn brace roots, bending of the stalks and some stalk breakage from wind and cultivation. The Golden Cross Bantan sweet corn appeared to be nearly unaffected in any of these respects by the 2,4-D spray. The earlier hybrids, W355, W464, W526, and R3 x M13 in particular showed considerable root proliferation. Stalks bent varied from 33 to 10 per cent with hybrids W641A and W692 being definitely less susceptible. Stalk breakage was not great in this experiment but 10 per cent of the plants of hybrids W464 and W692 were lost in this manner.

Grain yields varied from 83 to 104 per cent of the untreated check plots. The yields of the treated plots in per cent of the checks were 83, 85, 91, 91, 84, 86, and 104 per cent respectively for the hybrids W355, W464, W525, W606, W641A, R3 x M13 and Golden Cross Bantam. The yields of all of the dent corn varieties was reduced significantly by the 2,4-D treatment. The yields of the earlier hybrids appeared to be reduced the most. The yield of Golden Cross Bantam sweet corn was apparently unaffected by the 2,4-D treatment.

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Effect of Three Types of 2,4-D Formulations at Three Dosage Levels on Morphology and Yield of Corn as Well as Weed Control.

Noel S. Hanson (1)

This experiment was conducted to study tolerance of corn to 2,4-D applied for control of both annual and perennial weeds. Three types of 2,4-D were applied at dosages of 1/2, 1, and 1 1/2 pounds acid equivalent in 40 gallons of water per acre. Application was at the laying-by stage of corn and to bindweed, pigweed, buffalo bur, wild ground cherry, foxtail, and stinkgrass in the vegetative, rapid-growth stage. Application was with tractor-mounted equipment over the top of the corn.

Observations two days after treatment indicated considerable brittleness of the treated corn and some curvature of plants with typical curvature of weeds in inverse proportion to dosage. Later observations showed several broken plants in plots treated with 1.0 and 1 1/2 pounds butyl ester per acre. Considerable distortion of plants expressed through enlarged and cracked stalks, distorted brace root, and bending at the lower nodes was noted from all treatments with most intense effects from the butyl ester and least from sodium salt in inverse proportion to damage.

Ear formation was slightly reduced from all treatments but average ear weight was greater on all 1/2 pound plots than on the untreated. Root volumes on the average of 25 roots, were reduced below the untreated on all 1/2 pound plots but were greater from the 1 pound and the 1 1/2 pound plots of amine salt and sodium salt. While differences in root volume existed and some roots showed considerable fiberous root increase from 2,4-D, this phenomenon was not consistent. Yield was equal to and slightly above the untreated cultivated 3 times from the 1/2 pound treatments, but considerably reduced at the 1.0 and 1 1/2 pound levels. All yields were above the untreated cultivated twice. Bindweed control was nearly as effective at the lower dosages as at the higher.

(1) Assistant Agronomist, Nebraska Experiment Station, Lincoln.

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Effect of Three Types of 2,4-D Formulations at Three Dosage Levels on Morphology and Yield and Corn as Well as Weed Control. Average of four replications. Treated July 8, 1947 at laying-by stage.

Type 2,4-D	Dosage lbs./Acre	No. stalks observed	No. broken Stalks	No. Stalks Distorted	No. ears Developed	Av. ear Weight	Av. root Vol. in C.C.	Av. bu. per acre	Weed Survival per Square Rod: Bind-weed	Stink-grass	Fox-tail	Pig-weed	Buffalo bur	Ground cherry
Butyl ester	1/2	200	0	38	175	.40	138.92	23.7	51	45	12	9	6	18
Amine salt	"	"	0	26	187	.40	116.09	25.0	63	93	0	15	3	0
Sodium salt	"	"	0	23	161	.39	152.60	22.9	12	90	0	3	0	12
Butyl ester	1	"	33	180	165	.33	203.0	12.3	114	18	0	0	0	0
Amine salt	"	"	0	40	161	.36	172.6	13.3	36	63	0	0	6	3
Sodium salt	"	"	0	59	170	.29	162.4	12.4	57	51	0	0	0	15
Butyl ester	1 1/2	"	25	189	182	.36	146.20	15.1	12	45	0	0	3	0
Amine salt	"	"	0	74	156	.34	173.4	16.3	6	24	0	0	3	0
Sodium salt	"	"	0	45	150	.37	196.80	16.6	30	48	0	0	12	0
Check-two cultivations	0	"	0	0	111	.26	----	9.0	258	12	0	51	6	0
Check-three cultivations	0	"	0	0	189	.37	160.20	22.6	432	0	0	78	12	0

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Effect of 2,4-D Sprays on Sorghums, 1947

W. C. Elder (1)

Two grain sorghums and two forage sorghums were planted and cultivated. Weeds were removed with a hoe. When the plants were 1 ft. high the sorghums were sprayed at the rate of 1 1/2 gal. per sq. rod of 1/2 lb., 1 lb., and 2 lbs. per acre each of an ester and a salt type of 2,4-D. Oven-dry weights were taken for the forage sorghums and threshed grain weights were taken for the grain sorghums.

Results were very similar for the forage and grain sorghums and there was not a noticeable difference among varieties. Two lbs. per acre applications of 2,4-D definitely lowered yields in all plots. The plants in these plots lodged badly. In many instances the brace roots were abnormal and did not penetrate the soil. The 1 lb. applications per acre gave results just a little below the check plots. The ester type gave slightly lower yields than the salt for the 1 lb. and 2 lbs. per acre applications.

The 1/2 lb. applications gave an increased yield over check plots. More tests will be necessary to see if the light application acts as a stimulant to sorghum production.

(1) Assistant Agronomist, Oklahoma A & M College

Effect of 2,4-D on Sorghums

Treatment	Bu. per acre		Dry wt. per acre forage in lbs.	
	Darso	Kafir	Sumac 1712	Atlas Sorgo
No treatment	43.8	44.8	11,097	9,831
1/2 lb. salt per acre	47.1	49.6	12,280	10,817
1/2 lb. ester per acre	47.8	48.1	12,234	9,876
1 lb. salt per acre	43.1	43.9	11,075	8,560
1 lb. ester per acre	37.2	40.9	10,050	7,977
2 lb. salt per acre	32.2	33.5	9,551	7,529
2 lb. ester per acre	31.0	29.1	9,023	7,194

Effect of 2,4-D Sprays on Mungbeans

W. C. Elder (1)

Salt and ester types of 2,4-D were applied on mungbeans at the rate of 1/2 lb., 1 lb. and 2 lbs. per acre. Applications were made when the beans were 6 inches high and again just before blooming. Golden mungbeans, a forage bean, and Green mungbeans, a sprouting bean, were used in this test. Weeds were allowed to grow after planting.

The ester type was much more severe than the salt type on mungbeans, however more weeds were killed by the ester and the final yields of beans were about the same for both types.

The 2 lb. application arrested all growth for some time but did not kill the beans. The injured plants recovered and made fair yields.

The growth of the beans was affected in the 1/2 lb. per acre plots but they soon recovered and made good yields of forage and seed.

It was difficult to compare yields of the treated plots with untreated plots because they did not mature at the same time.

2,4-D treatments had about the same effect on the two kinds of beans. While mungbeans are somewhat susceptible to 2,4-D it is possible to use up to 1 lb. per acre and still get fair forage and seed yields.

(1) Assistant Agronomist, Oklahoma A & M College.

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Effect of herbicidal sprays on the Stands of Clover and Alfalfa

K. P. Buchholtz
Department of Agronomy, University of Wisconsin.

Nine herbicidal sprays were applied to oat plots intersown with clover and alfalfa. Sprays were applied when the grain was about 15-18 inches high. Legume counts were made after the grain had been harvested. All 2,4-D preparations were applied at the rate of 1 pound per acre of the acid equivalent. Of the dinitro materials such as Sinox W and Dow Selective, the former was applied at the rate of 8 pts. per acre, and the latter at 4 pts. per acre. Sinox was applied at the rate of 1 gal. per acre with 1 1/2 pounds of ammonium sulfate as activator.

Clover stands on plots treated with the ethyl, butyl and isopropyl esters of 2,4-D were 25, 47, and 29 per cent of check respectively. Alfalfa stand on these same plots were 2, 0, and 2 per cent of check. The plots treated with sodium ammonium and amine salts of 2,4-D had clover stands 99, 102, and 92 per cent of check and alfalfa stands were 26, 35, and 17 per cent respectively. Differences between different salts and esters were not usually significant but differences between the ester averages and the salt average were highly significant. Dinitro sprays were relatively more toxic to clover than to alfalfa. Clover stands of 86, 80 and 59 per cent were obtained for the Sinox W, Dow Selective and Sinox treatments. Alfalfa stands for these same treatments were 84, 110 and 117 per cent respectively.

Effect of Five Types of 2,4-D Formulations at Four Dosage Levels on Plant Tolerance and Yield of Dunfield Soybeans.

Noel S. Hanson and Henry Wolfe (1)

This experiment was conducted to determine maximum tolerance to 2,4-D by soybeans and differential tolerance of the various type formulations. The type formulations sodium salt, amine salt, butyl ester, isopropyl ester, and ethyl ester were applied to Dunfield soybeans at dosages of 1/8, 1/4, 1/2, and 1 pound acid equivalent per acre when the plants were in the vegetative pre-bud stage.

Observation 24 hours after treatment showed intense curvature and lodging of the soybean plants. Later recovery was in inverse proportion to dosage and varied by formulation. Final observations and yield determination were made October 15 to 20, 1947. Final results on percentage kill of plants showed no kill from either formulation at the 1/8 pound level and no kill from the sodium and amine salt at either the 1/4 or 1/2 pound levels. At the one pound level these two formulations caused 16 and 23 per cent kill of plants, respectively. The three esters caused kills varying from 8 to 14 per cent at 1/4 pound, 35 to 91 per cent at 1/2 pound, and 61 to 91 per cent at the one pound levels. The most severe kills resulted from the butyl ester and the least from the ethyl ester of the three esters. The sodium salt was slightly less severe than the amine salt. Yields were in inverse proportion to dosages in all cases varying from nearly equal to the check plots at 1/8 pound to nearly complete destruction of the crop by the butyl and isopropyl esters at the one pound level.

(1) Assistant Agronomist and Graduate Assistant, Nebraska Experiment Station, Lincoln, respectively.

Effect of Five Types of 2,4-D Formulations at Four Dosage Levels on Plant Tolerancy and Yield of Dunfield Soybeans, 1947

Dosage in lbs. per acre	Percentage plant kill and yield per formulation applied. (Av. 2 replications) Sodium salt		Amine salt		Butyl ester		Isopropyl ester		Ethyl ester		Average Per dosage
	% kill	Bu/A	% kill	Bu/A	% kill	Bu/A	% kill	Bu/A	% kill	Bu/A	
1/8	0	12.7	0	14.5	0	9.3	0	13.4	0	16.0	13.2
1/4	0	12.4	0	12.4	14	5.8	10	11.8	8	10.8	10.7
1/2	0	10.8	0	9.8	91	0.8	35	8.4	50	6.6	7.3
1	16	9.7	23	7.4	91	0.8	90	1.2	61	6.7	5.2
Ave. per Form.	40	11.4	58	11.1	49.0	4.2	33.7	8.7	29.7	10.0	9.1
Check	0	12.0	0	14.1	0	15.5	0	15.3	0	--	14.2

Effect of Date and Rate of Applying 2,4-D Sprays on Legume Seedling Stands

K. P. Buchholtz
Department of Agronomy, University of Wisconsin

In the spring of 1947 oat plots were intersown with 6 pounds each of alfalfa and red clover. The plots were sprayed with a sodium salt and a butyl ester 2,4-D preparation at the rate of 0.5, 1.0 and 2.0 pounds per acre of the acid equivalent when the grain was 4, 8, and 14 inches high. Legume counts were made after grain harvest in the fall.

All treatments caused reductions in the stands of clover and alfalfa. Clover stands on plots treated with the ester were about half of those on the sodium salt treated plot. Date of application affected the clover stand obtained being 43, 31 and 78 per cent of check for the 4, 8, and 14 inch application date. Clover stands 90 per cent of check were obtained by making applications of 0.5 pound of the sodium salt at the 14 inch stage. Alfalfa was considerably more sensitive to 2,4-D than was clover. The ester preparation injured the stand more than did the sodium salt. The average alfalfa stands obtained from sodium salt treatments made at the 4, 8 and 14 inch stage were 43, 14 and 56 per cent respectively. Approximately 60 per cent of check stands were obtained by using 0.5 pound of the sodium salt at the 14 inch stage.

The data suggest that the increased shielding afforded by the larger grain at the 14 inch stage and possibly a reduced susceptibility of the legumes to 2,4-D when grown in the partial shade of the larger grain favor the retention of legume stands in grain fields treated with 2,4-D sprays.

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Chemical Weed Control in Horticultural Crops

Regional Summary

Glenn Viehmeyer

The advisability of adding a section dealing with the problem of weed control in horticultural crops was brought to the attention of Pres. Noel S. Hanson, and he asked the author to take the responsibility of contacting cooperators and preparing a report on work being carried on in this particular field. This was done and as a result the following abstracts were assembled and mimeographed under the above heading.

Abstracts in this grouping for the most part fall under Uniform Experiments V, V-2, and VI-2. It was intended to include only papers dealing with horticultural crops in Experiments V and V-2 in this section but a number of abstracts falling under Experiment VI-2 were received late and were for this reason included in this section. The earlier papers on effect of soil treatments on horticultural crops were sent to Dr. Dunham who is summarizing Experiment VI-2 and persons interested in that phase of the problem are referred to his report on Experiment VI-2.

Various hydrocarbons such as Stoddard's solvent, the HB Aromatics Varsol (3139) Kerosene and various Diesel fuels have been used with considerable success in the control of weeds in carrots, dill, parsnip, onion and both table and sugar beets. At the present time these products seem destined to have an important place in weed control in those and perhaps other crops.

A number of phenolic compounds appear to have some promise but their use has been too limited to determine their ultimate value as herbicides. At this time the place of 2,4-D in controlling weeds in most vegetable crops appears to be limited to pre-emergence treatments. A number during the growing season.

The least injury was reported on large seeded vegetables such as beans, sweet corn and some of the curcubits. This may mean that the seeds are planted deep enough to escape injury while germinating.

A number of investigators have reported the successful use of the herbicide on potatoes while others have noted severe injury. Injury was most apparent to plants sprayed shortly after emergence. No investigator reporting injury from pre-emergence treatments.

Weed control in asparagus beds before and during cutting appears to be possible and the growth habit of the plant would seem to make it possible to spray during the entire season if proper booms that do not apply the chemical directly to the plant are used.

Preliminary work with raspberries and strawberries seems to indicate that 2,4-D will play an important part in weed control in those crops, and work with both raspberries and strawberries shows a high degree of tolerance in most varieties.

There is reason to believe that the use of 2,4-D will become a standard practice in the production of these fruits.

The salts of 2,4-D have been used in weed control in orchards with no apparent injury to trees if reasonable care is taken to prevent direct application to the trees.

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Some Newer Developments in Weed Control as Applied to Vegetables

Benjamin Wolf
The G.L.F. - Seabrook Farms Raw Products
Research Division, Seabrook Farms,
Bridgeton, New Jersey

Experiments with vegetables have indicated the possibility of effective weed control with chemicals. The chemicals used during the 1947 season along with their advantages and limitations are listed below:

1. Stoddard Solvents (a) The use of Stoddard solvents at rates of 80 - 160 gallons per acre as pre-emergence sprays for both beets and spinach was very effective as a herbicide when used at the right time. With this material, it is essential that weeds appear before the crop since only the weeds emerged or just emerging are killed. This is accomplished by preparing the seed bed some time before planting and allowing a large number of weeds to germinate. The crop is then planted with the least amount of disturbance to the soil. The spray is applied any time after planting but before any of the crop seedlings emerge. More effective control is obtained if the spray is applied shortly before emergence of the crop but is not always practical to do so. Applying the material in two applications, one half immediately after planting and the remainder before the crop emerges seems to have some advantage.

One advantage of this material is that it soon volalizes and leaves no harmful residue to affect the crops. Its primary disadvantage as compared to some other herbicides is in its cost which is relatively high However, the cost will still compare favorably with hand weeding of such crops.

(b) The use of Stoddard solvents for selective weeding in carrots was practiced on over 200 acres. The material was applied in sprays at rates of 80-100 gallons per acre and in several areas 2 applications were used.

The sprays were applied rather late when some weeds were already 6 inches high or higher. Under such conditions, it was not possible to control the weeds with one application. In the future, it is planned to apply the spray as soon as the carrots have two true leaves. Getting at the weeds when they are younger insures better control with less volume.

2. 2,4-D Erratic results have been obtained with this material for both beets and spinach. Until further knowledge as to its behavior in soils is obtained, its use even in "pilot plant" stage will be limited to irrigated acreage. Where moisture was controlled, it has given good weed control at rates of 1-2 pounds of 2,4-D acid per acre as the sodium salt. The 2,4-D was applied in 100 gallons of water per acre to moist fitted soil prior to planting the crop. The soil was irrigated one week later and crop planted without further disturbance of the soil as soon as soil moisture was satisfactory.

The application of 2,4-D to dry soil is evidently not very satisfactory for weed kill is poor. The irrigation of soil before planting avoids injury from any 2,4-D which still may be active.

The use of 2,4-D is relatively cheap weed control. If used so as to avoid injurious effects, it will have a definite place.

3. HB. Aromatics This material from the petroleum industry has given good weed control when used as a pre-emergence spray for spinach. As in the case of Stoddard solvents, weeds were allowed to germinate before planting the crop. A 10% emulsion of H-B Aromatics in water at rate of 100 gallons per acre gave fair control and at 200 gallons very good control. The spray was applied immediately after planting.

The relatively low cost of this treatment warrants further study with it.

4. Di-nitro compounds The use of Dow Contact and Dow Selective sprays at rate of 1-2 gallons per 100 gallons of water per acre as pre-emergence treatments gave fair control of weeds in spinach. The control of broad leaf weeds was good whereas the control of grasses was poor.

The use of these materials for beets was unsatisfactory because of rather heavy injury of beets.

5. Cyanamid Fairly effective control of large weeds in first year asparagus was obtained with Aero-defoliant cyanamid at rates of 275-300 pounds per acre. This material promises much more effective control if used when weeds are only a few inches high. The advantage of supplying nitrogen along with weed killing should not be overlooked.

Title - A Preliminary Study on the Value of Various Chemicals for the Control of Weeds in Onions *

Author - R. E. Nylund

Sponsoring Agency - University of Minnesota, St. Paul, Division of Horticulture.

Experiment I

The following phenolic compounds were compared with 3% sulphuric acid to determine their possible value as selective weedicides for onions grown on a muck soil; A, sodium orthophenylphenate; B, sodium trichlorphenate; D, sodium 2, chloro-4-phenylphenate; F, 2, 3, 4, 6 tetrachlorphenol (sodium salt); G, sodium pentachlorophenate; H, sodium tetrachlorphenate (technical); and I, ammonium salt of dinitro-o-secondary butyl phenol (Dow G562). Each of the above materials with the exception of Dow G562 and 3% sulphuric acid were applied at the following concentrations: 1/4, 1/2, 3/4. 1, and 1 1/2% by weight. Dow G562 was applied at the rate of three pints to 100 gallons of water. The chemicals were sprayed on the onions and weeds at the time the onion plants had one true leaf using a three gallon knapsack sprayer fitted with a Monarch No. 59 weed nozzle.

The only treatments which were superior to three per cent sulphuric acid as a weedicide for onions were A at 1 1/2% and B at 1 1/2%. The following treatments equalled 3% sulphuric acid in effectiveness: B at 3/4 and 1%, F at 1/2%, and G at 1/4%. All of the other treatments either were toxic to onions resulting in reduced stands and yields, or had no effect on weeds present.

Experiment II

In order to determine the possible value of some of the herbicides listed above when used at stronger concentrations on onions in the three leaf stage, another series of treatments were applied to onions seeded at the same time as those in Experiment I, but left unweeded until the onions had reached the three leaf stage. Weeds at this time ranged up to two feet in height. The following treatments were used: A at 2 and 3%, B at 1 1/2 and 3%, D at 3%, F at 1 1/2, 2 and 3%, G at 1 and 1 1/2%, H at 1 1/2, 2, and 3%, and Dow G562 and 3% sulphuric acid at the same rate as in Experiment I. Of the above treatments only F at 1 1/2% and G at 1 1/2% and 3% sulphuric acid gave fairly good control of weeds without reduction in yields of onions.

The results obtained in Experiments I and II indicate that at least some of the compounds tested appear to have selective herbicidal properties. However, more detailed studies of their action on various weed species and on onions must be conducted before recommendations for their use in agricultural practice can be made.

* Paper No. 606 of the Miscellaneous Journal Series, Minnesota Agricultural Experiment Station.

Spraying Beets with Salt Solution

A. L. Bakke
Iowa Agricultural Experiment Station

Young beet plants were sprayed with a concentrated solution of salt. The weight of beets taken from the unsprayed plots was 607 pounds, that from the treated plots 640 pounds. The beets from the control plots showed a sugar content of 15.9 per cent while the beets from the salt treated plots had a sugar content of 16.15 per cent. There was a saving of 1/3 in labor. Sprayed smartweed grew to a height of 9 inches while the unsprayed plants became 37 inches high.

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The Use of Sodium Chloride Spray for Weed Control in Onions

B. H. Grigsby
Michigan Agricultural Experiment Station, Section of Botany

Saturated sodium chloride was applied as a spray to seeded onions at the time when the second true leaf was just emerging. The solution was used at the rate of 100 gallons per acre. On muck soil, no reduction in stand of onions was found and only a slight temporary wilting of the young plants was observed. Satisfactory control of smartweed, ragweed, grasses, pigweed, and cinquefoil was obtained. Lamb's quarters were not affected by the spray. Yellow globe, white globe, and sweet Spanish varieties were included in the tests, but no significant differences in response of varieties were observed. Sweet Spanish types showed a more severe wilting, but recovery occurred in all plots. Yields were not reduced by the salt.

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Oil: Pre-emergence with 26 Vegetable Crops

E. K. Alban and V. E. Keirns

In June, during a period favorable for rapid weed germination, oil* at the rate of 100 gallons per acre was evenly applied to field plantings of carrot, asparagus, parsnip, dill, and radish approximately two days before crop emergence. No injury was noted on any crops, except a severe burning of a few radish seedlings that had emerged before treatment. All weeds above ground at the time of treatment were killed, and the area remained weed free for a two week period. Crops in the treated area grew far more vigorously throughout the balance of the season than did the same crops in the untreated area.

In late July and early August, during a period non-favorable for rapid weed germination, the experiment was duplicated using 25 vegetable crops. Again, no injury was noted on any crop. However, the treatment did not materially reduce the stand of weeds growing in the fast-germinating crops, and was effective only if applied at least seven days after planting, on crops such as parsnip, parsley, potato and spinach. The important weeds present included crabgrass, Syntherisma sanguinale, pigweed, Amaranthus retroflexus, purslane, Portulaca oleracea, and foxtail, Chaetochloa viridis.

* Stoddard Solvent, supplied by the Standard Oil Company of Ohio.

Oil: Post-emergence With Carrot, Parsnip and Dill

E. K. Alban and V. E. Keirns

Oil * was applied at the rate of 50 gallons per acre on field plantings of carrot, parsnip, and dill. One series of plots were sprayed in the 3-4 leaf stage; a second series were sprayed in the 4-6 leaf stage; and a third series were sprayed approximately two weeks after the 4-6 leaf stage.

No crop injury was noted from any treatment. At the time of the first series (3-4 leaf stage) most weeds were 4-8 inches tall, and the comparatively low gallonage (50 gallons per acre) was ineffective in controlling the weeds present. Some small weeds were killed, but the balance were merely checked in growth for a few days. The later treatments were even less effective as herbicides.

One section of the first series was re-treated four additional times over a three week period. The third treatment finished killing all weeds present. Injury was not noted on any crops until after the fifth treatment, which caused some yellowing of parsnip leaves. Following the fifth treatment, an objectionable flavor was also present in carrots harvested at this time.

The important weeds present included purslane, Portulaca oleracea, pigweed, Amaranthus retroflexus, crabgrass, Syntherisma sanguinale, and foxtail, Chaetochloa viridis.

* Stoddard Solvent, supplied by the Standard Oil Company of Ohio.

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Effects of Oil Sprays on Carrots

L. P. Spangelo and E. T. Andersen
Division of Plant Science, The University of Manitoba

Varsol (3139), diesel fuel (winter) and kerosene (Esso) (all Imperial Oil products) were applied to the foliage of Red Cored Chantenay carrots each at the rate of 80 gallons per acre. The applications were made when the plants were at the four to five leaf stage and three to five inches in height.

All three materials were effective in controlling weed growth, which was predominantly Red-root Pigweed (Amaranthus retroflexus L) and Purslane (Portulaca oleracea L.) as observed for one week following the treatments. Weeds were then removed in order to obtain accurate data on the effects of the treatments on root yields.

Harvesting was done when the plants were mature and the analysis of yield data (root weight) indicated no statistically significant reduction in yields with any of the materials applied.

The Use of Stoddard Solvent in Celery

B. H. Grigsby
Michigan Agricultural Experiment Station, Section of Botany

Stoddard solvent used at rates of 40, 60, and 100 per acre on celery seed beds gave complete control of weeds in the seed beds. Three applications of the lighter rate were made without injury on any of three varieties of green celery and three varieties of yellow celery.

Sprayed and unsprayed lots of each variety were transplanted in July and sprayed two weeks after transplanting. Two-thirds of the plots were sprayed a second time when the celery was 8-10 inches high. One third received three applications after transplanting.

Examination at harvest time, October 1st, showed some injury (black heart) due to the oil spraying. Injury was greatest in the yellow types and plots that had received a seed bed spraying were less injured than those not sprayed in the seedling stage.

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Stoddard Solvents for Weed Control in Carrots and Parsnips

B. H. Grigsby
Michigan Agricultural Experiment Station, Section of Botany

Three forms of Stoddard Solvent, with aromatic contents of 5%, 10%, and 12%, were used at the rate of 100 gallons per acre on carrots and parsnips which had just formed a second true leaf. Satisfactory weed control, 90% of annual weeds, was obtained.

These same materials used when carrots were 4-6 inches and weed plants were as tall, or taller than the crop plants. At this stage the 5% material did not give satisfactory control. The 10% and 12% materials were effective on weeds other than ragweed, beggars tick, and worm seed mustard. Some injury to the outer leaves of the carrots was observed in the 5% and 12% materials. Recovery occurred and no permanent effects were observed.

Stoddard solvents applied to carrots whose roots were 1/2 inch in diameter, produced oily flavor at harvest time.

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Effects of Sinox on Onions

L. P. Spangelo and E. T. Andersen
Division of Plant Science, The University of Manitoba

Sinox was applied to the foliage of Yellow Globe Danvers onions at three concentrations: 1/2, 1, and 1 1/2 gallons in 80 gallons of water, with each applied at an 80 gallons per acre rate. An activator, ammonium sulphate, was used with all treatments at the rate of one pound per 80 gallons of spray solution. The applications were made at two dates. At the first date, the majority of the plants were at the cotyledon leaf stage, with a small proportion having reached the second and third true leaf stages. At the second date the plant height averaged 9 to 10 inches.

Analysis of yield data (bulb weight) indicated a statistically significant reduction in yields with all concentrations at the first date and with only the 1 1/2 gallons concentration at the second date.

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Controlling Annual Weeds in Potato Fields with 2,4-D

A. L. Bakke
Iowa Agricultural Experiment Station

A number of broad leafed plants are resistant to 2,4-D. In this category is the potato plant. Since many potato fields are heavily infested with smart weeds, pigweeds and lamb's quarter at time of harvest, it seemed feasible to spray potato with 2,4-D when further cultivation will injure the roots. Since 2,4-D can be mixed with copper salts and DDT, it appeared logical to add 2,4-D to the Acme Red River Potato Mix where the active ingredients are basic copper arsenate, 56.50 per cent dichloro-diphenyl-trichloroethane (DDT) 9.50 per cent and inert ingredients 34.00 per cent. Two sprayings after July 29 of the mixture served to control the blight leaf hopper and the weeds. To cite one specific example where potato plants were sprayed with the Red River Potato Mix and 2,4-D (Tufor 40, one quart per 100 gals.) the results as determined by the yields were as follows: Sprayed 460 lbs., not sprayed 277 lbs. Whether the potato tubers will keep as well as those which have not been treated will be determined later.

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Experiments on the Resistance of Potatoes to 2,4-D

Keith C. Barrons and L. L. Coulter

In 1946 eight varieties of potatoes were sprayed when six to ten inches tall with herbicidal concentrations of the sodium salt of 2,4-D. Based on plant reaction and tuber formation they appeared to have a high degree of resistance except for Menominee and Russet Rural. Spraying older plants after tubers had set apparently caused yield reductions in all varieties. Tubers from sprayed potatoes stored well and grew normally in 1947.

In 1947 Russet Rural, Chippewa, Katahdin, and Green Mountain in a replicated plot test were sprayed when from three to ten inches tall with the sodium salt of 2,4-D at .35 and .70 pound of acid per acre. A trend toward a slight yield reduction under the control was found, but difference was not statistically significant. It is apparent that the low rates of 2,4-D can be used selectively for spot spraying of perennial weeds in potatoes. It might sometimes be used to advantage for emergency spraying when cultivation is impossible and the plants are still young. Further tests will be required before a recommendation for general spraying of potatoes can be made.

Contribution from the Dow Chemical Company, Midland, Michigan.

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The Use of 2,4-D Spray for Weed Control in Potatoes

B. H. Grigsby
Michigan Agricultural Experiment Station, Section of Botany

Butyl ester, sodium salt, acidified sodium salt, and triethanol amine salt, at the rate of 1 1/4 pound actual 2,4-D acid were applied to five varieties of potatoes. The potatoes were about one foot in height at the time of application.

None of the formulations killed the potatoes but formative effects were observed in some varieties. The acidified sodium salt produced the most severe effects upon foliage and reduced the size and total yield of tubers in all varieties.

The Pontiac and Chippewa varieties showed less foliage effects than the Cobbler, White Rose, and Russett Rural varieties.

Yields in all varieties were reduced by all formulations used.

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2,4-D: Post emergence With Mung Bean and Potato

E. K. Alban and V. E. Keirns

Concentration of .33, .66, and 1.32, and 1.98 pounds of the butyl ester of 2,4-D* per acre were applied to a field planting of mung beans. One series of plots were sprayed one week after emergence; a second series were sprayed three weeks after emergence; and a third series were sprayed five weeks after emergence. Concentrations of .33 and .66 pounds per acre were not effective herbicidal treatments for any appreciable length of time. The concentration of 1.32 pounds per acre, applied one week after emergence, controlled broad-leaved weeds and reduced the number and size of the grasses, with practically no injury to the crop. Later treatments with this concentration were not as effective. The concentration of 1.98 pounds per acre caused serious injury to the bean plants, but controlled all weeds present.

Concentrations of .13 and .33 pounds of the butyl ester of 2,4-D per acre were applied to a field planting of potatoes at three weekly intervals, starting as the crop was emerging, on July 1. The treatments were effective in reducing the weed population, but serious injury was caused to the potatoes.

The important weed species present included crabgrass, Syntherisma sanguinale, pigweed, Amaranthus retroflexus, purslane, Portulaca oleracea, and foxtail, Chaetochloa viridis.

* Agricultural Weed-No-More 40, supplied by the Sherwin-Williams Co.

Effects of 2,4-D on Potatoes and Onions

L. P. Spangelo and E. T. Andersen
Division of Plant Science, The University of Manitoba

The experiments were conducted during the summers of 1946 and 1947. The ammonium salt of 2,4-D was applied to the foliage of Red Warba potatoes and Yellow Globe Danvers onions at four concentrations; 50, 115, 263 and 600 ppm. (parts per million). Each concentration was applied at the rate of 200 gallons per acre. The 600 ppm concentration thus was equal to a 1.20 pounds (pure acid equivalent) per acre rate. The applications were made at three dates. The potato plants were 3 to 6 inches tall at the first date, a few flower buds present at the second date and in full bloom at the third date. With onions in 1946, applications were made on June 12 when the plant height was 5 to 6 inches, on July 2 and on July 19. In 1947 the applications were made on July 14 when the plant height was 2 1/2 to 4 inches, on July 28 and on August 7.

Analysis of yield data of potatoes (tuber weight) indicated a statistically significant trend of increased injury and reduction in yields with increased concentration at the first date. At the second or third dates no such trend was evident.

Analysis of yield data of onions, (bulb weight) indicated a similar significant trend at the first date. In 1946 at the second and third dates, no significant reduction was evident. In 1947 there was a statistically significant reduction with the heaviest concentration at the third date.

There was no apparent injury to either the tubers or bulbs with any of the treatments.

Average Plot Yields in Pounds of Potato Tubers and Onion Bulbs

	Concentration P.P.M	Pure Acid Equivalent (pounds)	Potatoes 1946	Potatoes 1947	Onions 1946	Onions 1947
1st Date of application	0	0	44.94	56.38	18.44	16.69
	50	0.10	34.34*	52.31	15.50	15.00
	115	0.23	40.14	49.88	14.12*	14.75
	263	0.53	32.45*	50.62	15.94	12.12*
	600	1.20	34.76*	44.50*	9.62*	7.94*
2nd date of application	0	0	42.26	60.06	14.31	15.88
	50	0.10	41.52	57.44	15.38	15.38
	115	0.23	39.58	53.12	14.69	17.69
	263	0.53	42.33	55.81	15.06	15.31
	600	1.20	42.20	53.75	15.00	13.69
3rd date of application	0	0	39.56	53.38	16.06	16.38
	50	0.10	46.20	45.75*	13.94	15.00
	115	0.23	40.00	52.44	17.52	15.81
	263	0.53	44.83	56.50	15.81	16.19
	600	1.20	39.39	52.38	12.84	12.00*

*Significantly different from check.
Potatoes - Necessary difference, 1946 (7.88) and 1947 (7.37)
Onions - " " 1946 (3.98) and 1947 (2.78)

Effects of 2,4-D on Carrots, Beets, Turnips and Peas

L. P. Spangelo and E. T. Andersen
Division of Plant Science, The University of Manitoba

The ammonium salt of 2,4-D was applied to the foliage of carrots, beets, turnips and peas at four concentrations; 50, 115, 263, and 600 ppm (parts per million). Each concentration was applied at the rate of 200 gallons per acre. The 600 ppm concentration thus was equal to a 1.20 pounds (pure acid equivalent) per acre rate. The applications were made at three dates.

Peas

At the three dates the plants were, respectively, 3 to 6 inches in height, early bloom, and full bloom stages. Analysis of yield data, (pod weight) indicated a statistically significant reduction in yields, with the 600 ppm concentration at the first date, with the 263 and 600 ppm concentrations at the second date, and with all concentrations at the third date. Very abnormally shaped and seedless pods resulted from the 600 ppm concentration at the third date.

Abnormal leaf shape (linear to lanceolate rather than the normal oval shape) resulted with all concentrations at all dates.

A high degree of susceptibility was indicated in these experiments by the 3 vegetables, carrots, beets, and turnips. Even at the lowest rates of treatment a nodular and much deformed root development occurred with all three crops.

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Chemicals for Weed Control in Asparagus

B. H. Grigsby
Michigan Agricultural Experiment Station, Section of Botany

75 pounds of Cyanamid, dusting grade, per acre applied at a time when weeds were 2 inches or less in height, gave control of lamb's quarter, pigweed, and crabgrass. This quantity was effective when weeds were wet with dew. 125 pounds per acre, applied two later, gave no control of weeds.

2,4-D at the rate of 1 1/4 pounds per acre (sodium salt) applied at the end of the cutting season, gave control of broad leaved weeds in asparagus. This treatment has been applied for two successive seasons and has not produced any apparent ill effects on the asparagus crowns. Young spears, hit by the spray solution have been distorted but new growth produced later in the season was not affected.

Control of broad leaved weeds was satisfactory, but grasses appeared much more abundantly in sprayed plots than in other areas of the field.

2,4-D as a Herbicide With Asparagus

E. K. Alban and V. E. Keirns

Concentrations of 1.32, 1.98, and 2.6 pounds of the butyl ester of 2,4-D* were applied to an established planting of asparagus immediately following the first cutting, on May 20. All concentrations gave adequate control of all weeds present throughout the cutting season, a period of five weeks. However, the two higher concentrations were more effective than 1.32 pounds per acre in controlling the grasses.

The same concentrations, applied to adjoining plots immediately following the fourth cutting of asparagus controlled the weeds, but the period required for killing was somewhat longer, due partially to the fact that the weeds were larger at the time of the latter treatments.

The above treatments caused distortion of all asparagus spears that were above ground at the time of treatment, or approximately 50% of the first commercial cutting following treatment. No adverse effects were noted on subsequent cuttings.

At the end of the cutting season, one plot not previously treated was disked. One week after disking the butyl ester of 2,4-D was applied at the rate of 1.32 pounds per acre, followed by an oil ** application of 50 gallons per acre. A special attempt was made to avoid contacting the growing tips of asparagus with the materials. This treatment controlled all weed species present, except Canada thistle, for a six week period. A few asparagus plants were slightly injured as a result of the treatment, but recovered in a few days.

The important weed species present in the asparagus planting included Canada thistle, Cirsium arvense, pigweed, Amaranthus retroflexus, crabgrass, Syntherisma sanguinale, and foxtail, Chaetochloa viridis.

* Agricultural Weed-No-More 40, supplied by the Sherwin Williams Co.
**Stoddard Solvent, supplied by the Standard Oil Company of Ohio.

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Weed Control in Asparagus

Hernandez, T. P., and Warren, G. F.
University of Wisconsin, Madison, Wisconsin

An experiment was conducted in 1947 in an eight year old asparagus bed on silt loam soil to compare the sodium salt of 2,4-D acid equivalent with granular Cyanamid as herbicides. The treatments consisted of 4 pounds of 2,4-D per acre applied as a surface application early in the spring before any spears were showing and 365 pounds of Cyanamid per acre concentrated in an 18 inch band over the row when the weeds were about 2 to 3 inches tall. Ammonium nitrate was added to the 2,4-D plots and the checks to give the same amount of nitrogen as supplied by the Cyanamid.

Neither of the treatments effected the yield or appearance of the asparagus spears as compared with the checks. Both treatments gave approximately a 90 per cent reduction in the number of weeds which consisted mostly of mouse-ear chickweed (Cerastium spp) and shepherds purse (Capsella Bursa-pastoria)

Application of 2,4-D to Soil as a Pre-emergence Spray to Prevent Lodging and to Control Weeds in Sweet Corn.

C. L. Hamner, H. B. Tukey, R. F. Carlson
Mich. State Quart. Bull. November 1947

Following up earlier work in which it was found that 2,4-D could be successfully used as a pre-emergence spray in gladioli plantings, it was found that if the sodium salt of 2,4-D were applied at the rate of five pounds per acre as a pre-emergence spray to corn growing in sandy loam soil, that adequate weed control could be obtained without reducing yield of corn. It was also discovered that the corn growing on the 2,4-D treated soil produced a more extensive root system and a much more developed brace of prop root system. As a result of the root stimulation, the corn plants were better anchored and withstood a severe windstorm which blew over all the corn in the control plots.

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Effects of 2,4-D on Sweet Corn

L. P. Spangelo and E. T. Andersen
Division of Plant Science, The University of Manitoba.

The sodium salt of 2,4-D was applied to the foliage of Marcross sweet corn at four concentrations: 250, 600, 1000, and 1500 ppm (parts per million). Each concentration was applied at the rate of 100 gallons per acre. The 1000 ppm concentration thus was equal to a one pound (pure acid equivalent) per acre rate. The applications were made at two dates when the plants were, respectively, 5 to 6 inches and 14 to 15 inches tall.

Analysis of yield data (kernel weight) indicated no statistically significant reduction in yields with any of the concentrations at either date.

Abnormal anchor root growth was very evident in plots of the second application. This effect increased with increased concentration. In many cases such growth prevented the anchor roots from reaching the soil. This could be a significant factor in predisposing plants to lodging. Preliminary tests on stem strength indicated that weakening, near the soil level, had occurred in the abnormal plants.

Pre-emergence treatments using two formulations, sodium salt and ester (butyl) at one pound per acre rate gave effective control of annual weeds, which were predominatly Red-root Pigweed (Amaranthus retroflexus L) and Purslane (Portulaca oleracea L) without subsequent injury to the corn plants.

Control of Weeds in Strawberry Plantings by the Use of 2,4-Dichlorophenoxyacetic Acid.

R. F. Carlson

Experiments have shown that 2,4-D can be used to control young succulent weeds in strawberry beds. Several concentrations were used ranging from 500 ppm to 2000 ppm. The strawberry plants were affected by the higher concentrations as was indicated by twisting of the petioles and misshapen fruits, while at the low concentrations the effect was slight. The control of weeds was satisfactory at all concentrations. Some varieties of strawberries respond differently to 2,4-D. For example, Robinson is more resistant than Premier.

Time of application and concentration of 2,4-D is important. The first year bed can be sprayed as soon as the weeds come up after planting in the spring. Since the 2,4-D has adverse effect on the flower buds, the fruiting bed should not be sprayed until after harvest. Best results were obtained where an aqueous spray of 500 ppm of 2,4-D was used shortly after the weeds had emerged. This concentration killed most of the troublesome broadleaved weeds without injuring the strawberry plants.

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Title: The Use of 2,4-D on Strawberries
Author: Homer B. Neville, Eugene C. Nutter, and C. J. Willard
The Ohio State University in cooperation with the Dow Chemical Company and the Sherwin Williams Co.

Three varieties of strawberries, Catskill, Fairfax, and Premier, set out in 1945, were treated on May 15, two days after a heavy frost which killed the first blossoms. The iso-propyl ester and the sodium salt were used at 1/2, 1, and 2 pounds per acre of 2,4-D acid equivalent. On May 22 there was an estimated 10% deviation from normal on the 1 pound rate in the form of the iso-propyl ester and of the 2 pound rate in the form of the sodium salt. Two pounds of acid in the ester form caused an estimated 33% deviation from normal. By June 15th, the affected plants were indistinguishable from the untreated. The fruiting stems were as straight, the fruit as perfect, and apparently in as great quantity. It was not possible to make actual yield tests. Later in the summer, applications on the same variety were made during the period of runner formation. The butyl ester and the sodium salt were used in rates up to 1 pound of 2,4-D acid per acre. There was no visible damage to any variety on any plot. Runners continued to set plants after the treatments.

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Effect of the Sodium and Amine Salts of 2,4-D on Strawberries

Glenn Viehmeyer
Uni. of Nebr. North Platte Substation, North Platte, Nebr.

The effects of the salts of 2,4-D indicate that there is a good possibility of controlling broad leaved annual weeds in this crop by the use of this herbicide. Of forty varieties of strawberry treated at the excessive dosage of approximately six pounds of the free acid, as the sodium salt, a few were killed or so severely damaged that recovery was unsatisfactory, but most varieties were not seriously affected.

Lower dosages of 1 lb. free acid per acre or less have in no case resulted in excessive injury to plants treated at any stage of growth. One lot of the variety Gem treated in full bloom producing an apparently normal crop. Dosages recommended for the control of seedling annual weeds do, on the more susceptible varieties, cause typical distortion of leaf petioles and blades and in some cases injury or death of the growing tips of young runners. However, in most cases observed, the injury was temporary and did not have a permanent effect on the vigor or productivity of the plants.

More information on dosage, time and rate of treatment, and effect on yields is needed before the herbicide can be recommended for commercial weed control in strawberries.

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2,4-D: Pre-emergence with 25 Vegetable Crops

E. K. Alban and V. E. Keirns

Concentrations of .13, .33, .66, and 1.32 pounds of the butyl ester of 2,4-D* per acre were used as pre-emergence herbicidal treatments with field plantings of 25 vegetable crops. The three lower concentrations were applied immediately after planting, on July 21, while the concentration of 1.32 pounds per acre was applied approximately 24 hours later.

The concentration of 1.32 pounds per acre caused practically no injury on sweet corn, snap bean, mung bean, potato and asparagus. In addition to the above crops, the concentration of .66 pounds per acre caused practically no injury on cucumber, lima bean, pea, and tomato.

In general, the concentrations of .13 and .33 pounds of the butyl ester of 2,4-D per acre, were not effective herbicides for any appreciable length of time, while the concentration of .66 pounds per acre gave adequate control of all weeds present for a three week period, and the concentration of 1.32 pounds per acre gave adequate control for about six weeks.

The most susceptible vegetable crops included the brassicae, with the exception of radish, and head and leaf lettuce.

The important weed species present included crabgrass, Syntherisma sanguinale, pigweed, Amaranthus retroflexus, and purslane, Portulaca oleracea.

* Agricultural Weed-No-More 40, supplied by the Sherwin Williams Co.

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Weed Control in Onions With 2,4-D Soil Treatments

G. F. Warren
Department of Horticulture
University of Wisconsin
Madison, Wisconsin

Several replicated experiments were conducted in 1947 to study the effect of applying 2, 3, and 4 pounds per acre of 2,4-D acid equivalent to peat soils as pre-planting and pre-emergence treatments to control weeds in

field sown onions. Pre-emergence sprays of the sodium salt of 2,4-D applied just before the onions broke through the ground gave from 50 to 90 per cent reduction in the number of weeds present at the time of the first weeding. The weeds which were not killed were severely stunted. The reduction was much less for the second weeding, varying from 0 to 30 per cent. Four pounds per acre gave only slightly better control than 2 pounds. The treatments were about equally effective on pigweed (Amaranthus retroflexus), lambs quarters (Chenopodium album) purslane (Portulaca oleracea) and several other weeds but smartweed (Polygonum spp) showed considerable resistance. There was no reduction in either the stand or yield of onions due to these pre-emergence sprays except in two experiments on poorly drained peat. In the latter tests, the injury varied from moderate at 2 pounds per acre to severe at 4 pounds. It is suggested that 2 pounds per acre would be an appropriate rate of application for future tests. A comparison was made of the sodium salt, amine salt and isopropyl ester preparations as pre-emergence sprays. These three preparations gave comparable weed control but the ester reduced the stand and yield of onions by 40 per cent and was therefore unsatisfactory. When 2,4-D was applied to the soil and worked in before planting, weed control was not as good as with pre-emergence sprays and the stand and yield of onions was greatly reduced.

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Weed Control in Potatoes with 2,4-D

Hernandez, T. P., and Warren, G. F.
University of Wisconsin, Madison, Wisconsin

A replicated experiment was conducted with Chippewa potatoes on peat soil using the sodium salt of 2,4-D. It was applied as soil treatments at the rates of 2, and 4 pounds per acre of the 2,4-D acid equivalent, each as a pre-planting treatment worked into the soil 3 inches deep, as a surface application immediately after planting, and as a pre-emergence spray just before the potatoes came up. In addition, one treatment was applied as a direct spray of 1000 ppm at 100 gallons per acre when the potatoes were approximately 8 inches tall.

The direct spray severely stunted the potatoes for a period of approximately 2 weeks but later they appeared normal. None of the treatments gave a significant reduction in yield compared with the check and there was no apparent effect on tuber quality.

The direct spray gave nearly 100 per cent control of the weeds present which were mostly pigweed (Ameranthus retroflexus). As compared with the checks, the 2 pound soil applications reduced the number of weeds by 38 to 60 per cent and the 4 pound applications gave a 64 to 74 per cent reduction. The weeds not killed were severely stunted. Weed control was slightly better where the 2,4-D was applied to the soil surface than where it was worked in before planting.

Title: The Use of 2,4-D for Pre-emergence Weed Control in Vegetable Crops*

Author: R. E. Nylund

Sponsoring Agency: University of Minnesota, St. Paul, Division of Horticulture

A preliminary test was conducted in 1947 in which the sodium salt of 2,4-D was applied on May 22 at the rate of 9 grams per square rod to peat soil in which spinach, beet, onion, and carrot seed had been sown on May 13. The 2,4-D was applied as a dust to the soil surface using sand as a carrier. At the time of application of the 2,4-D some spinach and beets had already emerged and were subsequently killed by the acid. However, later emerging spinach and beets and the carrots and onions were not visibly injured, while all the weed species present or emerging at the time of 2,4-D application, with the exception of Lady's tongue smartweed (Polygonum persicaria, L) were killed. Evidently non-germinating seeds were not injured as weeds were abundant in the field later in the season. This study will be continued and expanded in 1948.

* Paper No. 605 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota

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Experiment VI - Effect on Crop Plants of Residual 2,4-D in the Soil (1947)

T. B. Harrison
Senior Assistant, Horticulture
Dominion Experimental Station, Harrow, Ontario

The 2,4-D (Herbate-Ammonium Salt 77.6% acid equivalent) was applied in liquid form on sandy soil at two strengths, namely one and two pounds per acre, down two strips a rod wide, separated by a control strip on May 27 immediately after planting across these strips set onions, beets, carrots, snap beans, sweet corn, and tomato seed mixed with radish seed. One week, two weeks and one month later similar plantings were made across the treated strips except that tomato transplants were substituted for the tomato seed mixed with radish seed.

In general the ground application of 2,4-D restricted the development of broad leaved weeds such as lambs quarters and pigweed but later the treated plots became heavily infested with five finger grass and foxtail. The stand of beets and carrots was somewhat reduced by 2,4-D applied immediately after seeding and an abnormal forking of the carrot root occurred. The yield of set onions and snap beans was also reduced by the application of 2,4-D immediately after seeding. Sweet corn and tomatoes, however, were not affected by 2,4-D. The detrimental effect of the 2,4-D on the seed and plant development of beets, carrots, snap beans and set onions had altogether disappeared after two weeks as indicated by the growth response of the plantings made two weeks later after the ground application of 2,4-D.

Experiment V-2

VARIETAL DIFFERENCES IN CROP TOLERANCES TO 2,4-D

Regional Summary
Glenn Viehmeyer

Abstracts and reports from cooperating workers indicate a wide difference in tolerance to 2,4-D exists between varieties of a given crop. Differences in tolerance also exist within a variety at various stages of growth and are also apparently affected in some degree by such environmental factors as type of soil, soil fertility, temperature, etc.

At the present time the picture is not clear cut and the data scanty. A long series of investigations, under a wide variety of field conditions, will be necessary before final determination of varietal differences and their importance from the economic standpoint can be made. Present data, though admittedly fragmentary, seem to indicate that the minimum effective dosages of 2,4-D necessary for control of annual weeds is below the maximum safe dosage on many tolerant crop varieties. They also indicate that, in many cases, dosages recommended at the present time are too high to be used without injury to the crop plant.

A table of maximum safe dosages on various crops and crop varieties is given below. This table is a composite one taken from abstracts and reports from cooperators reporting on Experiments V and V-2. The dosages are those that, apparently, resulted in a minimum amount of injury to the more susceptible varieties of the crop.

Varietal Difference in Tolerance to 2,4-D in Corn as Shown by Percentage of Injured Stalks in Midsummer (Data from G. F. H. Buckley, Ontario) Dosage - 1 lb. methyl ester per acre applied in the six and five leaf stage.

Hybrid	% injury	Hybrid	% injury
Pfister 4897	3.5	Canada 645	27.2
Pride D-65	4.8	Canada 606	43.5
Harvic 300	5.3	Pioneer 322	43.5
Fung G-29	8.1	Canada 696	44.1
DeKalb 240	9.2		

Crop Variety	Maximum safe dosage that can be used without serious injury (lbs. per acre)							
	1*		2*		3*		4*	
	Salt	Ester	Salt	Ester	Salt	Ester	Salt	Ester
Barley								
Club Mariout					0.5	0.25		
Beecher					1.0	0.5		
Velvon	0.5	0.5			1.0	0.5		
Spartan					1.0	0.5		
Sanalta	1.0	1.0	2.0	1.0	2.0	0.5		
Titon	0.5	0.5						
Vantage	1.0	0.5						
Plush	1.0	0.5						
Montcalm			1.0	0.5	0.75	0.25		
Oderbrucker	2.0	2.0	2.0	2.0				

Oats								
Brunker					1.0	1.0		
Kanota	0.5	0.5			1.5	1.0		
Otoe					1.5	1.0		
Osage		0.125		0.125	1.5	1.0	3.0	2.0
Cedar			0.5	0.125	2.0	1.5	3.0	2.0
4301 (Nebr.)		0.125		0.125	1.5	1.0	3.0	2.0
Garry		0.5	1.0	0.5	0.75	0.25		
Exeter		0.5						
Victory		0.5						
Ajax		1.0						
(Scott, Sask)								
Ajax, Swift	0.5	0.25						
Current, Sask								
Larain	3.0	0.5	1.0	0.5	0.5	0.25		
Clinton			1.0	0.8				
Wheat								
Rescue	0.5		0.5	0.25				
Regent	3.0	1.0	1.0					
Redman			1.0	0.5	2.0	0.5		
Apex			1.0	0.5				
Pawnee	0.5	0.25	0.5	0.25	0.5	0.25	1.5	1.0
Thatcher			1.0	0.5				
Nebred	0.5	0.25	0.5	0.25	0.5	0.25	1.5	1.0
Flax								
Royal	0.25	0.1	1.0	0.15	0.5	0.25		
Redwing	1.0	0.25	0.5	0.25	0.5	0.25		
Soybean								
Dunfield	0.25	0.125	0.25	0.125	0.25	0.125	0.25	0.125
Bromegrass								
Lincoln	0.25	0.125	0.5	0.25	2.0	1.0	3.0	2.0
Buffalo Grass								
Common	0.25	0.125	0.25	0.125	2.0	1.0	2.0	1.0
Bluegrass								
Kentucky	0.25	0.125	0.5	0.125	4.0	3.0	4.0	3.0
Wheatgrass								
Intermediate	0.5	0.25	1.0	0.5	6.0	4.0	6.0	4.0
Tall	0.5	0.25	1.0	0.5	6.0	4.0	6.0	4.0
Lovegrass								
Sand	0.5		1.0	0.5	2.0	1.0	2.0	1.0

* 1 - seedling rosette; 2 rapid growth; 3 - bloom; 4 - post bloom - stages of growth.

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Some of the Effects of 2,4-D on Barley Varieties

Lyle A Derscheid (1)
Agronomy Department, South Dakota State College,
Brookings, South Dakota

Eight varieties of barley, Feebar, Odessa, Spartan, Kindred, Tregal, Wisc. #38, Manchuria and a Peatland x Dryland line, were compared for their responses to 2,4-D. Treatments of one pound of 2,4-D acid equivalent to the acre of a butyl ester, a triethanol amine, and a sodium salt were compared with "no treatment" at four stages of growth. The four stages of growth were (1) seedling, (2) fully tillered, (3) in the boot, and (4) in bloom.

All varieties, in all treatments, produced abnormal heads when treated in the seedling stages of growth; no other malformations were observed. These heads produced seed, but did not emerge from the sheath normally; they were pulled out of the sheath backwards by the elongation of the peduncle. The ester produced about 80% abnormal heads; the amine about 60%, and the sodium salt about 40%. One week after the "boot" stage, treatments had been made, several varieties treated with the ester were lodged, Odessa was the most affected.

An analysis of variance on yield produced an "F" value for "treatments" that is significant at the 5% level and an "F" value for "dates of treatment" that is significant at the 1% level. A minimum level of significance for "treatments" reveals that regardless of variety and regardless of date of treatment, the plots treated with the ester produced yields that were significantly lower, at the 5% point, than did the plots that were not treated. Likewise, a minimum level of significance reveals that regardless of variety and regardless of treatment, the plots treated in the "tillering stage" produced yields that were significantly higher at the 1% point than did plots treated at any other date.

The "F" values for the interactions "varieties x treatments" and "varieties x dates" were not significant indicating that a differential response in yields of these eight varieties to the treatments, or to the dates of treatment, was not obtained. The "F" value for the interaction "treatment x dates of treatment" was also not significant.

The average yields of eight varieties of barley in bushels per acre when treated with three formulations of 2,4-D at four stages of growth.

Dates of treatment	Treatments				
	Ester	Amine	Sodium	Untreated	Average*
Seedling	26.5	25.6	31.2	31.8	28.8
Tillering	31.8	35.8	35.9	31.9	34.1
Boot	22.5	31.4	30.1	30.2	28.5
Bloom	24.8	33.5	28.9	28.6	28.9
Average**	26.4	31.5	31.5	30.6	

* Least significant difference is 2.4 at 5% level and 4.2 at 1% level
**Least significant difference is 3.5 at 5% level and 6.4 at 1% level

(1) Assistant Agronomist, South Dakota Agricultural Experiment Station, Brookings, South Dakota.

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A Study of Differential Response of Varieties of Barley to Varied Dosages of Three Types of 2,4-D.

Henry Wolfe and Glenn Viehmeyer
Graduate Assistant, Department of Agronomy, University of Nebraska, Lincoln and Assistant in Horticulture, Experimental Substation, North Platte, respectively.

Four varieties of barley (Spartan, Velvon, Club Mariout, and Beecher) were treated with three type formulations of 2,4-D (butyl ester, triethanolamine salt and sodium salt). Dosages of 1/4, 1/2, 1, and 1 1/2 pounds per acre were

applied June 17 and 18 at a time when a majority of heads were emerging from the sheath. The varieties of barley were grown on relatively weed-free soil, consequently, competition due to weeds was negligible.

Two gross morphological effects, height reduction and lodging, were apparent as results of various formulations and dosages of 2,4-D.

In comparison to the check, the height of the varieties of treated barley were reduced from one to five inches. The greatest reduction in height for all varieties was in proportion to the dosage of butyl ester used. Very little variety difference occurred on the butyl ester treated plots; however, all butyl ester treated varieties were considerably shorter than either the amine salt or the sodium salt. A slight variety difference occurred with the amine salts and sodium salt. Considering only height, the varieties Spartan and Club Mariout were more tolerant to the salts than were either Velvon or Beecher.

The lodging effect which was evident was confined to the varieties of Beecher and Club Mariout, and at the higher concentration of butyl ester. Lodging occurred forty-eight hours following treatment and remained lodged throughout the experiment. The lodging was caused by bending of the second and third nodes following treatment, and was not due to any weakness of straw.

The Effect of Three Types 2,4-D Treatments at Different Dosages on the Average Height Taken from Three Replications in Each Variety of Barley, the Height Being Measured From the Ground to the Tip of the Rachis.

Dosage and type 2,4-D	Spartan Height in	Velvon Height in	Beecher Height in	Club Height in	Average for the four varieties Height in inches
1/4# butyl ester	31	29	23	26	27
1/2# " "	31.3	29	23	23	26.5
1# " "	29	25.6	21.3	24	24.9
1 1/2#" "	28.3	26.6	22	21.6	24.6
Ave. height for Esters	29.9	27.5	22.3	23.6	25.7
1/4# amine salt	32.6	28.6	23.6	26.3	27.7
1/2# " "	31.6	29	23.3	26.3	27.5
1# " "	33.6	30	23.3	25.3	28.0
1 1/2# " "	33.0	27.3	22	26.6	27.2
Ave. height for Amine salts	32.7	28.7	23.0	26.1	27.6
1/4# sodium salt	34.3	28	23	27	28.0
1/2# " "	31.3	27.3	23.6	25.6	26.9
1# " "	34.0	30.6	24	26.3	28.7
1 1/2# " "	31.3	29.3	22.3	25.3	26.8
Ave. height Sodium salt	32.7	28.8	23.2	26.0	27.6
Check plots	33.6	31.6	26.3	27.3	29.7

The effect of three types of 2,4-D at different dosages on the average amount of lodging taken from three replications of each variety of barley. Lodging caused by curvature at the second and third nodes.

Dosage and type 2,4-D	Spartan : Percentage lodged	Velvon : Percentage lodged	Beecher : Percentage lodged	Club Mariout : Percentage lodged
Butyl ester				
1/4 lb.	0	0	0	0
1/2 "	0	0	-10	-10
1 "	0	0	30	30
1 1/2"	-10	-10	75	90
Sodium salt				
1/4 lb.	0	0	0	0
1/2 "	0	0	0	0
1 "	0	0	0	0
1 1/2"	0	0	0	0
Amine salt				
1/4 lb.	0	0	0	0
1/2 "	0	0	0	0
1 "	0	0	0	0
1 1/2"				
check				

Differential response of oats and barley varieties to varied dosages of three types of 2,4-D.

Glenn Viehmeyer and Henry Wolfe
Assistant in Horticulture North Platte Sub-Station
Graduate Assistant, Dep't. of Agronomy, Lincoln Nebr.

Tests were conducted using four varieties of oats (Brunker, Kanota, Otoe and Osage) and four varieties of barley (Beecher, Club Mariout, Spartan and Velvon) to determine varietial reactions to the herbicide. Three types of 2,4-D (Butyl ester, triethanolamine salt and sodium salt) were used at four dosages (1/4, 1/2, 1 and 1 1/2 pounds per acre). Treatments were made June 17 - 18 when a majority of heads were emerging from the sheath. The crops were grown on weed free soil and weeds were not a factor in the check plots.

Results.

Oats:

While data on yield were affected by a part of the test area receiving runoff water following heavy rains during the growing season the greatest decrease in yields resulted from the 1 and 1 1/2 pound dosages of butyl ester, and with few exceptions reductions were in proportion to the dosages applied. Erratic yields were obtained with both amine and sodium salts with the highest yield obtained from sodium salt.

Varietial differences were evident but not particularly significent. With one exception (1 1/2 pounds of butyl ester per acre) the treated Osage variety consistantly outyielded the check plots. With few exceptions Kanota and Otoe varieties showed decreased yields. Brunker was the most erratic showing no clear pattern of response to the chemical.

Barley:

Barley yields were less erratic and more in relation to the formulation and dosage used. Yields were decreased, the greatest decrease occurring from the butyl ester treatments and in proportion to the dosage. No appreciable varietial differences in yield occurred. Beecher showed a slight reduction in test weight. Both Beecher and Club Mariout were lodged by the two higher dosages of butyl ester.

Effect of dosage and type of 2,4-D on yield of four varieties of oats. (Average of three replications) (Yield in bu. test weight in pounds)

Formulations used Butyl ester, Sodium salt, Triethanolamine salt.

2,4-D type	Lb. per A.	Brunker		Osage		Kanota		Otoe		Average	
		Yield	T.W.	Yield	T.W.	Yield	T.W.	Yield	T.W.	Yield	T.W.
Ester	.25	63.5	35	73.7	35	80.7	34	67.5	32	71.3	34
do.	.50	78.5	34	83.6	34	72.3	34	68.1	32	75.6	33
do.	1.0	59.6	35	83.0	35	66.4	34	64.7	31	68.4	33
do.	1.5	51.7	34	62.7	34	62.4	34	45.3	31	55.5	33
Amine	.25	69.2	35	78.8	34	78.5	34	70.0	32	74.1	33
salt	.50	55.7	35	73.4	34	69.2	35	60.2	31	64.6	33
do.	1.0	68.9	34	73.2	34	72.6	34	61.9	32	69.1	33
do.	1.5	77.6	35	82.1	34	74.8	34	68.1	33	78.1	34
Sodium	.25	76.2	34	73.7	34	84.4	35	67.8	35	75.5	33
salt	.50	80.7	35	97.6	34	72.3	34	66.7	32	79.3	33
do.	1.0	85.2	35	91.7	35	82.7	34	66.9	32	81.6	34
do.	1.5	63.3	34	76.8	35	77.1	34	68.1	31	71.3	33
check	0.0	63.6	35	72.3	34	82.4	34	77.1	32	75.1	33

Effect of dosage and type of 2,4-D on yield of four varieites of barley.

2,4-D type	Lb. per A.	Spartan		Velvon		Beecher		Club Mariout	
		Yield	T.W.	Yield	T.W.	Yield	T.W.	Yield	T.W.
Ester	.25	35.8	49	45.4	41	37.6	41	39.1	42
do.	.50	37.0	49	43.5	40	36.3	41	36.3	41
do.	1.0	34.6	48	42.9	41	34.6	41	37.7	41
do.	1.5	31.1	49	40.4	42	36.1	42	34.9	41
Amine	.25	44.4	49	47.1	42	43.4	42	51.4	43
salt	.50	41.3	49	50.9	41	41.4	41	42.8	42
do.	1.0	39.9	49	51.5	41	42.6	41	43.3	42
do.	1.5	41.6	49	52.6	41	41.4	42	46.1	42
Sodium	.25	35.1	49	45.3	40	37.4	41	42.5	42
salt	.50	38.8	49	44.4	41	38.6	42	43.1	42
do.	1.0	40.7	49	57.2	41	45.1	43	44.0	41
do.	1.5	39.7	50	46.7	40	36.3	41	38.6	42
Check	0.0	43.5	49	52.1	41	46.9	43	41.2	42

Some of the effects of 2,4-D on oats varieties.

Lyle A. Derscheid *
Agronomy Department, South Dakota State College, Brookings, S.D.

Nine varieties of oats, Tama Clinton, Bonda, Mindo, Marian, Vikota, Richland, Trojan and Brunker were compared in triplicate for their response to 2,4-D. Treatments of one pound of 2,4-D acid equivalent to the acre of a butyl ester, Triethanol amine, and a sodium salt were compared with "no treatment" at four stages of growth. The four stages of growth were: (1) seedling, (2) fully tillered, (3) in the boot and (4) in bloom.

The ester produced an "onion top" effect on all varieties when applied on the seedling stage of growth. The leaves were curled inward from both edges. This abnormality was most apparent one week after treatment, but was still present, to a lesser degree, at harvest. Many of the sheaths produced two or more panicles.

An analysis of variance on yields produced "F" values that were not significent for "treatment", "dates of treatments", and for the interactions "varieties x dates" and "varieties x treatments". Thus significent changes in the yields of oats caused by the different treatments or by the time of application was not established. Likewise a differential response in yields of these nine varieties to the treatments or to dates of treatment was not demonstrated.

The interaction "dates x treatments" was found to have a significent "F" value which is probably due to high yields obtained from plots treated with the Sodium salt of 2,4-D in the seedling stage and low yields obtained from plots treated with the ester in the fully tillered stage of growth.

*Assistant Agronomist, South Dakota Agricultural Experiment Station.

ABSTRACT

Effect of application of two dosages of butyl ester by airplane for weed control in two varieties of oats.

Noel S. Hanson, Assistant Agronomist, Nebraska Experiment Station, Lincoln.

An airplane spraying experiment was conducted on two varieties of oats in two different fields at Lincoln, Nebraska. The butyl ester of 2,4-D was applied at two dosage levels of 1/4 and 1/2 pound in 2 gallons diesel fuel per acre when the oats plants were 4 to 6 inches tall and in the pre-jointing stage. The spray was applied with a Stearman PT17 biplane with belly tank for the solution, propellor-driven pump, and underwing spray boom.

Flight was at the height of approximatly 3 feet above ground at 80 miles per hour. Swaths 78 feet wide were covered per flight. Glass slides laid out on the field during the flights intercepted 50 to 65 droplets per square inch. Droplets averaged approximately 1/16 inch in diameter.

Results noted at time of maturity indicated an opposite response in the two varieties. The treated Osage variety matured 2-3 days earlier than the untreated. The 4301 variety was delayed in maturity by 2-3 days. An indeterminate type of growth was induced in the 4301 with four different specific stages of tillering -- (1) mature culms (2) early dough stage (3) blossoms in anthesis, and (4) tillers 1 to 3 inches tall. Maturity was uniform in the Osage. Many steril florets were noted in the heads of both varieties when treated. Yield at the 1/4, 1/2 and 0 dosages were 42.2, 41.6, and 75.9 respectively for Osage and 40.9, 32.2, and 70.5, respectively for 4301.

Effect of application of two dosages of butyl ester by airplane for weed control in two varieties of oats. (Treated 5/2/47 when oats were 4-6 inches tall.)

Variety	2,4-D type	Dosage per acre	Relative maturity to check	Test weight	Yield per acre	Weed control effect					
						Sunflower		Pennycress		Smartweed	
						% D	% A	% D	% A	% D	% A
	Diesel fuel diluent	pounds	Days	pounds	bushels						
Osage	butyl ester	1/4	2-3 earlier	26	42.2	95	5	95	5	65	35
"	" "	1/2	"	27	41.6	97	3	100	0	80	20
"	check	0	normal	30	75.9	0	100	0	100	0	100
4301	" "	1/4	2-3 later	34	40.9	--	--	98	2	25	75
"	" "	1/2	2-3 later	35	32.2	--	--	98	2	45	55
"	check	0	normal	36	70.5	0	100	0	100	0	100

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Varietial differences in corn hybrids in tolerance to 2,4-D

G.F.H. Buckley, Sr. Assistant, Forage Crops.
Dominion Experimental Station, Harrow, Ontario, Canada.

Nine corn hybrids were sprayed with 2,4-D acid, methyl ester compound, at the rate of 1.0 pounds per acre. One gallon of spray was used per square rod. The hybrids used in this experiment are some of the most popular hybrids grown in southwestern Ontario.

Upon the basis of the limited data available, the results would indicate the following.

1. There is a marked difference in tolerance among the hybrids to 2,4-D in the methyl ester form.
2. The reduction in stand was most evident with the hybrids, Pioneer 322 and Canada 696.
3. When the percentage of injured plants is considered, the hybrids fall into two distinct groups - very susceptable and moderately tolerant. The first group shows from 27 to 44 percent of the plants severely injured, while the latter group shows less than 10 percent.
4. As the season advanced there was considerable recovery among the hybrids, though those in the susceptable group were not as vigorous as the tolerant group.
5. Effects on yield and kernel quality cannot be ascertained until after harvest, early in November.

Varietial differences in corn hybrids in tolerance to 2,4-D.

Date planted, May 30, 1947: Date treated June 25, 1947: Plot size 22 hills (2 x 11) 42" rows.: Treatment - 1 pound per acre - Methyl ester base 40%. Applied as a spray at 1 gallon per square rod.

Corn Hybrid	Number of plants		% Reduction in stand	Number of plants showing severe effects		% of plants showing injuries
	June 25	July 8		June 30	July 3	July 3
Canada 606	57	53	7.0	20	23	43.5
Canada 696	49	43	12.5	11	19	44.1
Canada 645	60	59	1.7	20	16	27.2
Funks G29	62	62	0.0	10	5	8.1
Pioneer 322	63	53	15.9	25	25	43.5
Pfister 4897	58	57	1.7	3	2	3.5
DeKalb 240	65	65	0.0	3	6	9.2
Pride D-66	64	63	1.6	5	3	4.8
Harvic 300	58	57	1.7	10	3	5.3

NOTE: As corn will not be harvested before Nov. 1st no yield data can be supplied at this time.
"Canada" hybrids have the same parentage as Wisconsin hybrids of the same number but are produced from breeding stocks maintained in Canada.

ABSTRACT

Varietial differences in tolerance to 2,4-D in Strawberries.
Glenn Viehmeyer, Uni. of Nebr. Substation, North Platte, Nebraksa

The sodium salt of 2,4-D was applied to 40 clones of hybrid strawberries to observe the effect of the chemical on varieties of this fruit. The herbicide was applied heavily so that all parts of the plant, including the buds of the crown, were thoroughly drenched with the 1000 ppm solution. The application was estimated to be about the equivalent of six pounds of the free acid per acre.

Effects of the treatment on roots, crowns, foliage, runners and stems were studied. Effects ranging from slight injury to nearly complete kills were found. Some clones were very tolerant while others were comparatively susceptable to the herbicide.

Three hybrid progenies and three commercial varieties were included in the test. These were: F_1 Fragaria ovalis x Fairfax; a backcross, Fairfax x (F. ovalis x Fairfax), a double cross, (Fairfax x F. ovalis) X (Dorsett x F. ovalis), and the commercial varieties Dunlap, Midland and Premier. The hybrid progenies all had selections that differed in degree of tolerance to the herbicide and different degrees of tolerance were evident in the three commercial varieties as well.

The experiment indicates that differences in tolerance, wide enough to be economically important, exist between strawberry varieties and that some varieties of this fruit possess enough tolerance to 2,4-D to make weed control without serious injury to the crop a possibility.

Distribution by grade of the effect of 2,4-D on foliage, crowns and roots of the members of three hybrid progenies of strawberries.

Plant part studied	Highly tolerant				Intermediate			Susceptable	
	- Index of effect -								
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0
	Number of variates falling into each class.								
	Progeny I								
foliage	0	0	1	2	3	1	0	1	1
crown	0	2	3	0	3	0	0	0	1
root	0	2	1	0	1	0	2	2	1
	Progeny II								
foliage	1	1	2	1	1	2	2	4	3
crown	3	2	0	2	0	2	2	2	4
root	0	2	1	0	1	2	3	1	7
	Progeny III								
foliage	0	0	4	1	1	1	1	0	0
crown	0	0	4	1	1	1	1	0	0
root	0	0	2	0	2	2	1	1	0

Index 1.0 equals slight effect on a few parts.
3.0 equals all parts affected.
5.0 equals serious injury or death to parts.
The other index numbers are intermediate in effect.
Plants receiving an index below 4.5 have fully recovered and are normal.
Foliage and crown were graded on distortion and/or death of plant parts.
Roots were graded on amount of root proliferation.